SCIENCE LIBRARY

McGraw-Hill Co., Inc. Largest Circulation of Any Mining and Metal Journal in the World 25 Cents Per Copy

February 4, 1922

ENGINEERING AND MINING JOURNAL

A Weekly Journal of the Mining and Mineral Industries

The Steward Mine, at Butte, Montana

One of the four mines of the Anaconda Copper Mining Co. to reopen on January 16

The Feld Scrubber for Cleaning Metallurgical Smoke

By W. L. Lamoreaux

The Calumet & Arizona

By J. H. McClintock

The Joplin District in 1921

By Jesse A. Zook

Biography of Samuel John Truscott

The awarding of the silver medals given by *Engineering and Mining Journal* to the members of the shaft-sinking crew of the Walter Fitch, Jr., Co. took place at Eureka, Utah, on January 19. This crew sunk 427.5 feet at the Water Lily shaft in thirty-one days.

Mining companies pay half of the total taxes levied in Arizona. An estimate of the burden carried is given in this week's news. In Minnesota, where mines are also taxed exorbitantly, a fight is on against the new occupational state tax on iron-ore operations.

For Distributing—

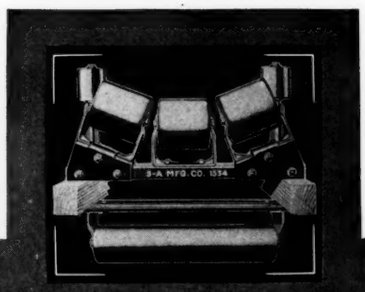
A ground storage is well accomplished with belt conveyors and wide range bedding trippers. The trippers may be designed to be power driven and automatically operated.

Call in an S-A Engineer on your storage proposition and secure advice which is based on a broad knowledge of industrial requirements.

"S-A Belt Conveyors," Catalog No. 26, contains complete detailed data concerning advanced practice in belt conveyor design. A copy should be on every engineer's desk for quick reference.

Ask For Your Copy

Stephens-Adamson Mfg. Co.
Aurora, Illinois



J. E. SPURR
Editor
G. J. YOUNG
Western Editor
D. E. A. CHARLTON
Managing Editor
A. H. HUBBELL
News Editor
E. H. ROBIE
Metallurgical Editor

Engineering and Mining Journal

F. E. WORMSER
W. N. P. REED
Assistant Editors
BENJAMIN L. MILLER
ROBERT M. HAIG
J. VOLNEY LEWIS
Special
Consulting Editors

Volume 113 | New York, February 4, 1922 | *Number* 5

The Need for Organization Among Miners

WE HAVE before called attention to the farmers' bloc in the Senate as an example of the mass action of the agricultural industries, and compared the corresponding need for concerted action for protection and better conditions on the part of that other great basic raw-material industry, the mining industry. Recently, Secretary Wallace of the Department of Agriculture has summoned a farmers' conference; and before that conference in Washington President Harding has pointed out the fact that the nation cannot be prosperous unless the farmer is prosperous, and, what is more significant, declared himself in favor of organized and centralized marketing as one of the remedies to be applied to the present serious agricultural situation.

Good enough: and this reminds us again of the analogous plight of the mining industry. There is a growing tendency toward solidarity in the Senate of a group composed mostly of Senators from the Western states, which group is entirely in sympathy with any just and broad plan for the advancement of the rights and prosperity of the mining industry. There is no reason why this should be confined to the West: nearly every one of our states are great mining states, Pennsylvania, by virtue of its coal mines, the greatest of them all.

But who is going to summon the representatives of the mining industry to a conference in Washington over the mining situation, as Secretary Wallace did for the farmers, or Secretary Hoover did for the farmers? There we see our poverty of representation. Whatever responsibility for the mining industry there may be in the Cabinet, theoretically, we suppose resides with the Secretary of the Interior; but speaking from an intimate knowledge of the facts, this has practically amounted to no special representation at all, and this applies all down the line, and includes the present incumbent, Secretary Fall. It is plain, therefore, that we need a Department of Mines at once, and a Secretary of Mines, as Representative Rhodes, of Missouri, Secretary of the Committee on Mines and Mining, in his article in our Annual Progress Number, pleads. And in the Senate an ever-increasing number of Senators whose constituencies have a prime interest in mining have been privately pledging their support to the bill for the establishment of a Department of Mines.

Our continued survey of the situation reveals that the mining industry has great need of being mothered: not coddled, but given a fair chance with the rest. If marketing is the chief problem of the agricultural industries—and it is—it is no less true that marketing is the chief problem of the mining industries. And we are as far from any efficient system or even any knowledge of the principles of the subject as the farmers are.

What can you do? Support vigorously a Department of Mines, as a starter. The Nicholson bill provides for the establishment of a Bureau of Mineral Markets within this department, which Bureau of Mineral Markets is very much to the point of this discussion. The Department of Agriculture has a Bureau of Markets. The American Mining Congress, the directors of the Bureau of Mines and the U. S. Geological Survey, the chairman of the Committee on Mines and Mining of the House of Representatives, and *Engineering and Mining Journal* are among the representative factors in the mining industry that are unequivocally in favor of a Department of Mines. Push for this and make it a fact; and then we shall be ready for the next most necessary step, following the excellent example of the farmers.

Mining Engineer Insurance

THE MINING ENGINEER is a soldier of industry and even a soldier of fortune. He is a soldier, often, without a regiment or a protecting organization behind him. Combining as he does all the fresh and manly qualities of the intrepid adventurer with the conscientiousness of the technically and scientifically trained man and the caution of the business man, he is unquestionably the finest type of man that we have ever rubbed up against.

But his life, though adventurous and free, is not an easy one. Especially when—as he does—he attaches unto himself a wife and a few children—does his problem become increasingly difficult. Should he play in bad luck—should he drown in a tropical river, or be stricken with fever in Africa, or be slain by the hill men in Asia, it may be that his family become stranded under unusually trying circumstances. If not death but hard times—depression in mining, due to a mad world war brought on by fools in Europe—come upon him, he is unusually liable to be caught without sufficient funds or other sheet anchors to windward against the parting of the main hawser. A mining engineer may be careful, successful, and broke at thirty or forty, which combination is not so easy to find elsewhere.

And during his career he, of all professions, has often been least able to put out roots and form ties which will aid him or his family in time of unexpected stress. He has drifted from one part of the world to the other, from camp to camp, served one business group after another, and his social tentacles have not taken deep hold anywhere. Friends are widely scattered, and not intimate, though cordial. He does not belong, as a rule, to the various fraternal societies which lend a hand in case of need and which usually include in their program some form of emergency insurance. His case, or that of his surviving family in adversity, is apt to be a particularly trying one, as we happen to know from many instances. Who cares? asks a recent correspondent. He belongs to the American Institute of Mining and Metal-

lurgical Engineers, but that is a technical society, and is a connection no more personal than his relation as a subscriber to *Engineering and Mining Journal.*

The principle of insurance and that of the helping brotherly hand are pretty good things. They are the sound justification for the existence of labor unions. This insurance, the miners—the manual workers—have. The mine owners have their own forms of insurance in the shape of reserve budgets. Can the men who furnish the technical brains of the mining combination—who stand between the two and are the guides and the only safeguard of both—likewise insure themselves against sudden drops in their curve of work and prosperity? It is worth pondering over.

The principle of group insurance has become more and more widely recognized as a sound safeguard, and many companies, having in certain cases thousands of employees each, see to it that each employee is protected by a certain sum, to be paid to his family in the case of his death. Would it be practicable for such a group insurance plan to be conducted by the American Institute of Mining and Metallurgical Engineers? The argument to the contrary will be that the Institute is a technical society. And this argument will call for a definition of the position, field, and aims of the Institute, for which the time has otherwise come. The organization, besides its original technical function, has branched into the civic field, through the Federated American Engineering Societies, and into the social field, as especially instanced by its Women's Auxiliary; and it has even ventured into the field of technical journalism.

As to fraternal insurance of mining engineers as a group, besides the evidently practicable suggestion which we made above, there remains the highly debatable thought concerning unemployment insurance. We were recently surprised and confounded when Mr. Seebohm Rowntree, an English cocoa manufacturer, showed that his company had successfully maintained unemployment insurance for its thousands of employees: and afterward we privately found out that at least two large companies in Massachusetts, one of them the well-known Dennison Manufacturing Co., had also been successfully carrying this on for some time. Having thus been convinced against our own judgment, it occurs to us to inquire how much more difficult it would be to provide unemployment insurance for a group like the mining engineers than for a corresponding number of industrial employees grouped around a single great company.

A Community Development Project in Leadville

A RATHER NOVEL METHOD of organizing and financing a mining enterprise is that initiated by the Leadville Chamber of Commerce, which chose a committee to select the most favorable area in the Leadville district for development, this committee consisting of mine operators and mining engineers. A place on Canterbury Hill, where the geologic features were considered very favorable, in the light of past experience, was selected, and a company was incorporated for $150,000, of which over 100 Leadville men subscribed $50,000, and the remaining $100,000 was sought outside of Leadville. The circular states "Revival in mine production insures increased prosperity to all. Unison of effort only will revive the game, and Leadville points the way." The officers of the company are subscribers and serve without salary.

This is a plan which interests us and brings forth our best wishes of success. Those behind the plan—the citizens of Leadville—have put their own money into it; and whatever they get will be out of the ground, not out of stock sales or salaries. The ordinary citizen is more attracted by remote ventures for his surplus capital than by opportunities at home; and for all of us the Leadville people are setting a good example, and one that invites respect and sympathy. If the enthusiasm of the supporters has anywhere been excessive, it has been in that part of the letter inviting outside co-operation, where it is stated that the enterprise is "designed as a safe investment as well as to generate revival of mining interest so essential to all other industry." The framers of this evidently conservative and worthy project could not have carefully considered the word "safe." Few mining enterprises are "safe" as investors understand the term, which means a practical lack of risk; and no exploration or prospecting enterprises deserve that term. They are business ventures, and are to be looked upon as such; and if successful, the rewards are commensurate; but the investor must be ready to philosophically kiss his money good-by, if need be. It is a business man's venture, not a place for the funds of needy widows.

Those who would claim that the mineral resources of Leadville are exhausted—if there be any such—would be far bolder than we. We look forward to discoveries other than those already made. Concerning Canterbury Hill, we are not sufficiently informed; but there are places in the district which have come under our notice, even like Fryer Hill, in the Down Town district, where we anticipate the ultimate discovery of new orebodies, in spite of unsuccessful attempts that were made in the past.

In Darkest Brooklyn

THE UNTUTORED OBSERVATIONS, ruminations, and conclusions of prospectors and others who come into contact with rocks and ores is proof that everyone is, to the best of his ability, a geologist. Only the lack of training and sound experience leads such observers, young in science, though old in years, afar. Witness the article on "How Granite Is Formed," published in *The Golden Age*, which is printed in Brooklyn:

"I have traveled over the waste places of the earth, and from both observation and inquiries have come to the conclusion that granite is formed from a sticky mud called gumbo. This mud is found in great quantities on the prairies of Northwest Canada; and in the Rocky Mountains is sometimes cut into when a new railway is being made. I have seen it myself, and have also been told by men in charge of the work in railway cuts that it was granite in the formation. One may ask how it came there. The answer is that it was deposited by water countless ages ago. The crystalline appearance of granite is due to the salinity of the moisture it once contained.

"On the coast of Alaska rises a huge granite cliff out of the water with a 4-ft. seam of coal running across the upper face. If this mass of granite had been formed from lava, there would have been no seam of coal in it."

The author (Mr. Truzzell) adds some observations concerning the shifting of the poles:

"The equator was in another part of the earth when the present mountains were made, and is now moving imperceptibly each year north or south, probably south. One cannot guess the age of the earth with correctness; it is certainly thousands of millions of years old. We have

trees 6,000 years old here in California. There has been no change of the earth in their locality since they first started to grow."

But the sapient editors of *The Golden Age* will not let Mr. Truzzell's statements go unchallenged and uncorrected. In an editorial note they observe:

"*The Golden Age* believes that Mr. Truzzell is in error in thinking that the equator is moving appreciably or has ever moved appreciably. The location of coal deposits in the Arctic Zone is not to be explained in that way, but by the fact that prior to the Flood the whole earth was enveloped in a canopy of moisture which made it a vast hot-house. Prior to the Flood we read: 'The Lord God had not caused it to rain upon the earth, but there went up a mist from the earth, and watered the whole face of the ground.' We think it quite possible that some of the sequoias of California, and possibly a few of the deep-sea monsters, are the only living things on the planet that have survived the days of Noah."

Paleontological Society of America please take note: also Don Marquis, author of the ballad, "Noah and Jonah, and Captain John Smith."

How far Brooklyn is from New York! We had never realized it before. Evidently the proper way to count the distance is to go due west from New York till you reach Long Island.

The Bursting of the Fisher Bubble

AS EXCLUSIVELY ANNOUNCED in our editorial columns in our issue of Dec. 31, the sensational discovery of Professor Irving Fisher, of Yale, that Germany was about to produce artificial gold in such quantities as to make gold no longer practicable as a medium of exchange, has been found to be an error. Only Professor Fisher did not know it till Jan. 24, when a reporter found the Yale savant in Berlin and was told by him that he had that day discovered the claim to be without foundation. His methods of discovering his error are much in line with his method of making his original great discovery. He says, "I saw a distinguished German scientist this morning, and he told me the man is a fraud and has a prison record." All very well until someone else gives him an earful day after tomorrow.

Professor Fisher would not make an understudy for Sherlock Holmes. But he has some weak justification of his hopes for worthless gold. He says that the German government has made serious attempts to produce gold from sea water. Wrong again, professor: ask anybody. Besides, the Yankees are still ahead. It was a Maine man, and a clergyman at that, who worked the gold-from-sea-water game on the American public. The Yankees score once more over the Dutch.

Also, Professor Fisher says that it has been found that all the rivers of Germany, such as the Rhine, carry a little gold in solution. If Professor Fisher would come home—and we really wish he would—he would find that all the rivers of New England carry a little gold in solution, even the Naugatuck that flows hard by New Haven; and that the waters of Long Island Sound carry a little gold in solution, as has been known for many years.

We are sure that the Yale economist will finally bring a gold brick home unless somebody puts him on board ship soon. And why, finally, does Professor Fisher keep talking about "synthetic" gold? Synthesis is the opposite of analysis. It is the combination of elements to form a compound. If we ever get artificial gold, it will be by the transmutation from another element into the gold element.

Another Bubble Burst

A FEW DAYS AGO a brief announcement appeared in an inconspicuous place in the daily press, stating that the Edge bank plan had been abandoned. The entire account took but a few inches, yet what reading could be done between the lines! It was the funeral notice of a grandiose scheme conceived after the Armistice to facilitate the retention of the huge export trade gained during the war and the capture of more. It involved the organization of a huge corporation to finance foreign trade with long-term credits.

It will be recalled that the belief was insistent a few years ago that the United States was destined to become the world's greatest international trading agency and that it was endeavoring to supplant Great Britain—to make the dollar replace the pound sterling. This hope has gradually dwindled, and, viewing the political and industrial attitude of the country, how could it be otherwise? How can a great nation like ours, which yowls about importations made with cheap German labor, when imports amounted to but $73,000,000 from Germany compared with exports of $351,000,000 to that country in the first eleven months of 1921—how can that country hope to be a great foreign trader? The record of our trade with Canada, Mexico, and other countries was just as lopsided. It would seem that all we are anxious to do is send our products to every corner of the globe, but to take nothing but gold in return—and how absurd that idea is we all know.

Pick up a copy of one of the London financial journals and you will find statements regarding the condition or possibilities of developing the hair-tonic industry in Siam or copper mines in the fastnesses of Asia. Glance through an American paper of similar type, and what does one find? Nothing discussed but domestic enterprises and investments. Few foreign enterprises are listed on our exchanges, and then only the Canadian Pacific Ry. and Canadian and Mexican mining enterprises, or some foreign bonds.

And what has all this to do with mining? Just this: The American mining engineer has been a pioneer in the development of not only his own country's mineral resources, but also of those of other lands—South America, Australia, Asia, South Africa, to mention a few wide stretches, and he naturally views with regret the forced abandonment of a plan which for a time looked promising enough to help place the country on a new plane in foreign commerce.

The Institute's Directors' Meetings

A GRACIOUS CUSTOM of the Board of Directors of the American Institute of Mining and Metallurgical Engineers is to hold their meeting in public—to the extent that at each meeting a number of the Institue members are invited, resident or visitors, and after a pleasant dinner of the directors, officers, and guests, the guests sit interestedly by while the board transacts its business. The proceedings of such meetings are private in the sense that they are not for publication, but public in the sense that free discussion of the meetings may circulate by word of mouth to some degree. We do not know how far back this custom originated, but it is a noble gesture, if we may use the phrase, on the part of the directors. It is unavoidable that some private or pressing matters should be discussed and partly settled in committee: nevertheless these semi-public proceedings of the board are frank and free.

WHAT OTHERS THINK

Another Peculiar Effect in Photographing Uneven Surfaces

Referring to the photograph of the interior of a Hardinge mill lined with rail sections and cement, on page 900 of *Engineering and Mining Journal* of Nov. 3: The effect obtained, when reversing the photograph, of causing the depressions to look like protuberances and vice versa, is the result of the change in the direction of lighting.

We had an example of this in a photograph of a large relief map reproduced in the "1914 Report of the Minister of Mines for British Columbia." This photograph was taken with the lighting from the top left-hand corner, and this agrees with the letter of J. C. Seelig in the Dec. 24 issue, on page 1,005.

I send you a copy of this photograph and you will find that by looking from the left side or top the depressions will appear as ridges and the creeks to run along the ridges. If your photograph had been printed the other way up the question would not have arisen.

Victoria, B. C. H. T. NATION.

A PHOTOGRAPH OF A RELIEF MAP WHICH, WHEN VIEWED UPSIDE DOWN, MAKES THE RIVERS APPEAR ON RIDGES

Electrostatic Separation Not Dependent Upon the Weather

Under the heading "Echoes From the Fraternity" in the Dec. 31 issue of *Engineering and Mining Journal* is a two-column article entitled "Separation Problems Under Study by Bureau of Mines," outlining plans which have been formulated by the U. S. Bureau of Mines for the complete survey of the milling problems of the Tri-State district of Missouri, Oklahoma, and Kansas. In this article a paragraph is devoted to a comparison of work done by the flotation process and by the electrostatic process, which reads as follows:

"The second method employs flotation. Tests gave a higher recovery of zinc than was obtained by electrostatic separation, but the spar product is lower grade and finer grinding is necessary. The method, however, is a great improvement over earlier methods, and as compared to electrostatic treatment is preferable in stormy weather."

Apparently the writer of this article is not acquainted with the progress made in electrostatic separation during the last ten years, and this reference to the electrostatic process is wholly misleading and not helpful to the engineering profession, and particularly to the manager, superintendent, or research engineer interested in milling or concentrating problems.

In the early days, prior to 1901, considerable experimental work was done in a laboratory way with electrostatic separation, but nothing of a practical value was accomplished until 1901, when a series of patents covering electrostatic separation was granted to Mr. Dolbear, Professor Blake, Mr. Huff, Mr. Pickard, Mr. Wentworth, and others. These patents followed over a period ranging from 1901 to 1910. The first commercial use of the electrostatic process in the separation of zinc was carried on by the use of the process as operated under the Blake-Mosher patents. At this time the weather conditions seriously affected operation, owing to the fact that a frictional static disk was employed to generate the electrostatic current to effect a separation. This type of generator had been used for years in most schools to demonstrate the action of electrostatic electricity, but commercially it proved to be a failure, and the results were disappointing.

About 1904 Charles H. Huff took an interest in the process, and, realizing its possibilities, employed several expert engineers who developed a new electrical generating set which overcame the difficulties experienced with the static disk machine. A series of patents was granted to Mr. Huff, Mr. Pickard, and Mr. Wentworth covering these later developments. Several plants were installed, and all proved to be satisfactory. The process, operating under the Huff patents, has been in active operation in the plant of the U. S. Smelting Co. at Midvale, Utah, for the separation of iron and zinc since 1908, and this plant has been operating twenty-four hours daily through all kinds of weather.

During the last eight years twenty-six plants have been installed using the Huff process, in the United States, Mexico, Canada, Newfoundland, Norway, Spain, and Australia. These plants have been operating at various altitudes ranging from sea level to 12,000 ft.

and under all kinds of climatic conditions. The process is installed at one plant at Pablo Beach, Fla., where the separating plant is built out on the beach and the fog at times is so thick that it is almost impossible to see an object ten feet distant. Never during the last eight years has a single complaint been made regarding the electrical equipment, which is just as steady and dependable in operation as any electric power line. The action and operation of the process is really just as reliable as that of any concentrating process on the market today; in fact, on most problems, in comparison with flotation, it is simple to operate and very easy to control.

The electrostatic process has many decided advantages in the treatment of a large variety of materials, and it is unfortunate that the erroneous impression mentioned is at various times circulated in reports covering laboratory work where the frictional static disk has been employed. In justice to the process as well as to the engineering profession I have taken this opportunity of setting forth the facts. The electrostatic process has many advantages and is worthy of serious consideration and investigation by every engineer interested in the concentration of ores or of byproducts where there is a difference in electrical conductivity sufficient to effect a commercial separation.

Arlington, Mass. HERBERT B. JOHNSON.

Magnesite From California and Greece Compared

In *Engineering and Mining Journal* of Jan. 14, 1922, H. C. Boydell asks for the facts concerning the comparative quality of magnesite from California and Greece. While a member of the U. S. Geological Survey, I studied the magnesite deposits of this country and published in "Mineral Resources of the United States, 1918," Part 2, more than forty analyses of magnesite from California. In the accompanying table are given a few of these analyses made in the chemical laboratory of the U. S. Geological Survey from samples collected by Federal geologists.

No. 1 is from the mine operated recently by C. S. Maltby. Nos. 3, 4 and 5 are from one of the largest deposits of the state. No. 8 is from the locality formerly worked by Tulare Mining Co. and more recently by the Sierra Magnesite Co.

These analyses are of the materials most nearly like the Grecian magnesite which Mr. Boydell describes. There is a wide range in composition of magnesite from other localities in California, some of them showing as high as 12 to 15 per cent of silica. That there may be a considerable range in the composition of the magnesite in different parts of a deposit is shown by analyses 3, 4 and 5, in which the silica content ranges from 0.14 to 1.10 per cent and the lime from 0.59 to 1.17 per cent. It is apparent by comparison with the analyses given by Mr. Boydell and repeated in the table herewith that some California magnesite is slightly purer than the Grecian material which he sampled and some is not so pure.

	Locations	Analyst
1.	White Queen Mine, Red Mountain, Santa Clara County, Cal.	Chase Palmer
2.	Alameda claim, Red Mountain, Santa Clara County, Cal.	A. J. Peters
3.	Sampson Peak deposit, San Benito County, Cal.	Chase Palmer
4.	Sampson Peak deposit, San Benito County, Cal.	W. B. Hicks
5.	Sampson Peak deposit, San Benito County, Cal.	J. G. Fairchild
6.	Eckert ranch, Cloverdale, Sonoma County, Cal.	A. J. Peters
7.	Eckert ranch, Cloverdale, Sonoma County, Cal.	A. J. Peters
8.	Success, Tulare County, Cal.	A. J. Peters
9.	Deer Creek, Tulare County, Cal.	P. H. Bates
10.	Euboea, Greece, 2,500 tons	P. A. Zalacostos
11.	Euboea, Greece, 1,500 tons	P. A. Zalacostos

R. W. STONE.

Pennsylvania Geological Survey, Harrisburg, Pa.

The E. M. and the Mining Engineer

Referring to J. P. Varian's lament in the Jan. 7 issue of *Engineering and Mining Journal*, under "What Others Think":

No doubt the *Journal* doesn't care, or at least can't. If a man will begin to look for something to do in other lines than mining and metallurgy, he will soon find they are all in much the same boat; and the *Journal* no doubt has its hands full with paper, postage, and payroll problems as acutely pressing as the idle E. M.'s next plate of ham and eggs. But the idea of the sacrifice of the best years of life for training being sufficient to merit a pension is slightly amiss. The country—in fact the wide world—is full of graduate C. E.'s, M. E.'s, and E. M.'s, whose cost of replacement is little more than common labor turnover.

We shouldn't overlook the great chasm between an E. M. and a Mining Engineer; the former, as a graduate at least, can lay legitimate claim to being little more than a tin-horn surveyor; the mining engineer has everything technical plus a knowledge of business in his make-up. He is not so easily replaced; hence he is retained during a depression while the E. M. is kissed good-by.

Facts are stubborn things, and no amount of emotion or contradictory opinion will change them. The chasm between the two types is bridged in just one way: long, hard, grinding routine work, which in time, to the live wire, will saturate him with the necessary knowledge of business methods. And then he may be justly ranked as an engineer. No, it isn't an appealing situation, but bemoaning the fact cannot change it. If a man is easily replaced, then he is going to be out of work in a depression; if not, he will be retained. Leave short-cuts to big pay for the motion-picture magazine advertisers.

Men are *developed* for the big jobs, but not in two weeks. And the years of downright plugging are the years that count. Care? No; nobody cares but your wife and the grocery man. It is up to the E. M. to absorb the big idea of business, and to become a Mining Engineer; or to coddle his slide rule and forever remain a surveyor. PAUL H. KEATING (E. M.).

Golden, Col.

ANALYSES OF CRUDE MAGNESITE FROM CALIFORNIA AND GREECE

	1	2	3	4	5	6	7	8	9	10	11
SiO_2	0.50	0.73	1.10	0.81	0.14	0.51	0.23	0.80	0.31	0.86	1.54
Al_2O_3	....	0.14	....	0.00	0.48	1.98	0.04	0.42	0.11	0.55	0.33
Fe_2O_3	....	0.21	....	0.52		0.16	0.20	0.20	0.08		
FeO	0.20	....	0.72	....	....	....	....	....	....	....	....
CaO	1.92	0.40	1.17	1.04	0.59	0.59	0.19	1.02	0.24	0.55	1.21
MgO	45.90	46.61	45.64	46.67	47.07	45.84	46.88	45.94	47.22	46.94	46.38
CO_2	51.68	51.52	51.20	50.60	50.66	50.80	51.77	51.30	51.64	51.10	49.84
	100.20	99.61	99.83	99.64	98.94	99.88	99.31	99.68	99.60	100.00	99.30

The Feld Scrubber for Cleaning Metallurgical Smoke

Installation at the Ducktown Smelter, in Tennessee, Uses the Purified Gas for Manufacture of Sulphur and the Recovered Fume in the Production of Electrolytic Zinc—Ionization Theory Successfully Applied

BY W. F. LAMOREAUX*

Written for *Engineering and Mining Journal*

SMOKE AND FUME, escaping from metallurgical plants into the atmosphere, has been the source of endless controversy for several decades, and in this country has been the cause of bitter and costly litigation. As a result, many ingenious methods have been devised to overcome the escape of noxious elements and, where practicable, to recover and convert these into valuable byproducts. Metallurgical smoke, as those products have been aptly named, is usually composed of three distinctly defined components:

1. Solids: "Flue dust" and small particles readily acted upon by gravity.

2. Fume: Volatile constituents which, upon reduction of temperature, become condensed or sublimated in the form of infinitesimally small particles which have only a slight tendency to settle.

3. Gases: Usually invisible, and almost entirely unaffected by gravity.

These components may be either soluble or insoluble in water, and many of the elements or compounds that are insoluble in water may be readily soluble in some other media. However, the value of the recovered product may depend entirely upon whether it can be obtained in a dry or wet condition. And, furthermore, the residual gases, after removal of any previously contained suspended matter, may be desirable for subsequent use, in which circumstance the temperature of the gases or their moisture content may be determining economical factors; thus, in the manufacture of sulphuric acid from smelter gases it is important that sufficient temperature be retained in the gases to carry out the Glover-tower reactions; and in the cleaning of iron-blast-furnace gases for combustion in gas engines or for pre-heater requirements, it is important that the moisture content be reduced to the lowest possible amount. These various requirements have influenced or limited the methods of purification of metallurgical gases as well as the recovery of their contents in the form of commercially valuable products.

VARIOUS CLEANING METHODS

The various methods of cleaning gases may be classified in the following order:

Type of Apparatus and Principle and Scope of Operation

1—Gravity: Stagnation of gases, decreased velocity and settling of dust particles in rectangular, balloon or kite-shaped flues; catenary flues; U-shaped and zigzag flues. Employed principally in the recovery of flue dust and heavy particles of solid matter, although, with adequate provisions for cooling, liquid condensates can thus be recovered.

2—Baffling: Interposed plates, wire screens, and Roesing suspended wires, designed to afford increased surface for lodgment of dust particles.

3—Filtering: Use of mattings of various kinds of fibers; woolen and cotton bags; layers of coke, slag or mineral wool as filter materials. Employed for the recovery of fume and very small particles of solid materials.

4—Freezing: Gayley's method of refrigerating, for the removal of moisture and dust contents of gases.

5—Electrical: The Cottrell process of electrostatic precipitation of dust and moisture particles. Not recommended for cleaning inflammable gases, or gases containing inflammable dust particles.

6—Tangential: Dust-laden gases are introduced tangentially into vertical cylindrical shells with sufficient velocity to throw out the heavier dust particles. Employed for the removal of dust or liquid particles having higher specific gravity than that of the gases to be cleaned.

7—Spraying: Dust-laden gases are caused to flow through streams of atomized water, or through checkerwork or grids over which water is continuously sprayed.

8—Centrifugal: The dust-laden gases are caused to pass through chambers wherein water or any other liquid is atomized by means of rapidly revolving impellers. The Feld gas scrubber belongs to the centrifugal type of gas-cleaning apparatus, and combines in its operation all of the functions of gravity, baffling, spraying, and centrifugal removal of the dust or fume particles contained in dust-laden gases. In addition, the Feld scrubber may be employed as a reaction or absorption apparatus for use in chemical reactions.

POSSIBILITY OF WET SCRUBBING

For a number of years there has been among metallurgists much uncertainty, even to the extent of skepticism, as to whether the metallic fumes contained in smelter gases can indeed be precipitated by any wet method. Heretofore such fumes have been precipitated or recovered almost solely by gravity settling in long flues, often of complicated design, or more successfully by means of filtration through various fabrics, particularly woolen bags. Many of the largest smelting plants in this country have adopted the installation of baghouses of enormous sizes and erected and maintained at great cost, to recover the fume contained in their waste gases. In most instances this has been done to avoid damage to vegetation; in other circumstances the fume carried elements of considerable commercial value as recoverable byproducts. But a method of recovering these fumes by means of gas washers or "scrubbers" has either not been developed or sufficiently demonstrated to the point of warranting adoption for commercial use.

Liddell states that "the ferrous metallurgist uses the centrifugal gas washer, but it seems doubtful whether they (the washers) would have any effect on the lead—or copper—smelters' fumes."

Fulton, in referring to wet scrubbing, states: "The method removes flue dust with fair success, but it is

*General Manager Ducktown Sulphur, Copper & Iron Co., Ltd., Isabelle, Tenn.

not satisfactory for fume, so that the statement may safely be made that the application of water to the smoke stream in various ways for the removal of fume holds out little promise."

In detailing the qualifications necessary for a successful system of wet condensation, Hofman says:

"An efficient condensation of smelter smoke in this way must do three things: (*a*) reduce the temperature of the gas current to the point at which dissolved moisture forms a mist or fog; (*b*) saturate the floating particles with moisture; (*c*) separate the saturated particles."

Conditions at the Ducktown Plant

It was in the light of such knowledge that the Ducktown Sulphur, Copper & Iron Co., Ltd., undertook to solve the problem of cleaning the waste gases emitted in its copper-smelting operations, with the purpose of utilizing the purified gases in the manufacture of elemental sulphur and also to use the recovered fume in the production of electrolytic zinc.

The ores smelted at this plant have about the following average percentage composition:

Copper	2.30	Alumina	3.20
Zinc	3.75	Lime	7.85
Iron	31.50	Magnesia	2.30
Sulphur	20.85	Undetermined	3.25
Silica	25.00		
			100.00

The gases leaving the furnace contain 6 to 8 per cent, by volume of sulphur dioxide and the fume content—about 2.2 lb. per 1,000 cu.ft. of smelter gases—has about the following percentage composition:

Moisture	6.62	Arsenic	0.19
Sulphur (*a*)	21.85	Selenium and tellurium	0.17
Lead	4.88	Antimony	nil
Zinc	43.78	Manganese	nil
Copper	0.14	Aluminum	nil
Iron	2.31	Potash	nil
Lime	0.25	"Insoluble"	0.78
Magnesia	0.02	Undetermined, oxygen	18.86
Cadmium	0.15		
			100.00

(*a*) The sulphur content shown in the above analysis is distributed as follows: As free sulphur, 6.01 per cent; as free sulphuric acid, none; sulphuric trioxide, 5.43 per cent; as sulphides, 10.41 per cent; total, 21.85 per cent.

It will be seen that the ore contains more zinc than copper. Of course the copper is recovered in solid form in the smelting operations, but most of the zinc appears in the fume; indeed, it is the zinc compounds that impart to the waste smelter gases their characteristic whitish or pale yellow appearance.

The principal zinc compound in the fume is the oxide. In the ore, the zinc occurs as sphalerite or blende, ZnS, and, upon entering the blast furnace in admixture with coke, it is first reduced, and then, in the escaping gas stream, is eventually oxidized to ZnO. At the exit of the furnace stack, the smoke stream has the characteristic yellow color of hot zinc oxide, but this color rapidly disappears a short distance away from the stack and the smoke or fume has a white or grayish-white color.

Cool Gases Essential to Quantitative Recovery

Both metallic zinc and zinc oxide possess comparatively high vapor tensions even at very slightly elevated temperatures, and for this reason they do not ordinarily condense or become completely reduced to sublimates until cooled to atmospheric temperatures; furthermore, on account of their great dilution in the gas stream their partial vapor pressures are more than ordinarily reduced, and consequently even lower temperatures are required for their condensation than in such processes as the Witherill process of zinc-oxide sublimation. Therefore, with this type of fume it is almost impossible to effect a quantitative recovery without cooling the gases to a comparatively low temperature.

To those interested in the cleaning of blast-furnace gases, a brief description of the various experiments tried at Ducktown may prove of interest and value.

Centrifugal Cleaners, Dry Process

The first method employed in these experiments consisted in passing the gases through a centrifugal cleaner. This apparatus consisted of a cylindrical sheet-metal shell, 36 in. in diameter and 60 in. high, having a conical bottom and flat top. The inlet pipe for the gases was attached to the shell so that the gases entered tangentially near the top of the shell and developed a whirling motion. In so doing the gases encountered a number of deflecting plates, which in turn augmented the tangential course of the gases, thereby causing the heavier floating particles of dust to be thrown outward and downward while the purified gases were removed by suction from the outlet at the top and center of the collector. Practically all of the coarse particles of dust were collected in this manner and removed from the trap, conveniently arranged at the lower end of the cone-shaped bottom.

This apparatus successfully removed the "flue dust" and heavier particles, but was entirely inadequate for the separation and removal of the fume content. The principle of operation is such that the particles of dust must possess sufficient size, or rather mass, to be susceptible to the centrifugal as well as to gravitational force, while being temporarily suspended by virtue of the velocity of the gases. With minute particles of solids, such as compose the fume, the gravitational effect is practically nil, and, likewise, the centrifugal force acting upon the small particle of fume is inappreciable.

This principle of gas cleaning is widely and successfully employed in the iron industry where centrifugal cleaners are placed directly following the downcomers from the blast furnaces. They serve the purpose of primary cleaning, but, to remove the finer material, the gases are subsequently treated in some form of wet-scrubbing apparatus.

Baffle Washer, Wet Process

Another type of cleaner tried out was one of the "cone and baffle" washers. This apparatus was first tried with passing dry gases through it, without material efficiency of cleaning. Next, it was arranged to deliver a continuous spray of water at the top while admitting the gases at the bottom. By this means, practically all of the coarser particles of dust were removed, although but little, if any, of the fume. Finally, a much heavier spray of water was introduced, sufficient to form a film of water over the exposed surfaces and to cause a shower of liquid to fall from each cone to the next baffle below. This proved much more effective and removed a part of the fume, but the volume of water required was prohibitive, even though means were available at the time for the recovery and re-use of the wash water.

As in the operation of the centrifugal cleaner, the apparatus is only serviceable for the removal of flue dust and coarse particles, although it showed a pronounced indication that the fume can be to some extent removed from the gases by wet-scrubbing methods.

A great many experiments were undertaken, using coke as a filtering medium, for the removal of the fume contained in the blast-furnace gases. A filter bed 12 ft.

wide and 16 ft. long was filled in with a layer of coke about 4 to 5 ft. deep, of graded sizes, the largest pieces being placed upon the bottom. The first layer of coke, about 1 ft. deep, consisted of sorted pieces about 4 to 6 in. in diameter, hand picked and carefully placed in position; next followed a 1-ft. layer of coke about 2 to 3 in. in diameter; upon the top of this was placed a third layer composed of pieces about 1 in. in diameter, and finally a layer of coke breeze consisting of screened coke about ¼ to ½ in. in diameter. The placing and leveling of the coke was carefully done to avoid crushing or compacting of the finished filter bed, thereby assuring uniform resistance to the passage of the gases through the coke.

Drains were provided in the floor beneath the filter bed so that the coke mass could be sprayed with water and washed free of zinc fume. Water-spray nozzles were arranged at the top of the chamber so that a well-distributed and finely divided spray of water could be thrown downward upon the top of the filter bed. The gases entered beneath the floor, passed through a number of perforations, and thence upward through the coke bed.

Wide Scope of Experimentation

A great many experiments were tried: (*a*) Varying the depth of the coke bed; (*b*) varying the volume of gases, and, correspondingly, their velocity through the filter bed; (*c*) varying the temperature of the gases; (*d*) varying the amount of wash water from the sprays, and (*e*) eliminating the sprays of wash water.

The first experiments were conducted with dry coke (without the use of wash water). A fair degree of cleaning was noted, but in a short time the resistance of the filter bed rose so rapidly (to 6 and 8 in. hydrostatic head) that the centrifugal fans were unable to deliver a sufficient volume of gases for practical requirements.

The coke was then washed with water, allowed to drain as thoroughly as possible, and the experiments were repeated, in every instance being terminated by the prohibitive rise in resistance in the coke mass, owing to coating and clogging of the coke with fume.

Next, the water sprays were operated intermittently, without success; and finally a continuous spray of water was employed. In the latter experiment, the resistance to the passage of the gas was prohibitive, and when the depth of coke was decreased to remedy this difficulty, the cleaning effect was greatly diminished. All attempts were almost equally ineffectual. With a cleaned coke filter bed, the resistance, or pressure drop, was equivalent to about one inch of water for each foot of depth of coke employed, and effective cleaning could not be obtained with less than 4 to 5 ft. of depth. As stated, a fresh filter bed became clogged and obstructed in from three to four hours when filtering the gases at a rate of approximately 250 cu.ft. per hour per square foot of filter area. It was, therefore, apparent that to maintain a continuously effective filter bed, the coke would have to be removed and replenished at frequent intervals and at considerable expense. Unfortunately, too, the coke, after having once become contaminated with fume, could be cleaned only with great difficulty, apparently because a part of the soluble constituents of the fume crystallized in the minute pores of the coke.

The next method employed was that of filtration of the blast-furnace gases through woolen bags. The gases were introduced (after preliminary cooling) at a temperature of about 120 deg. C. so as not to endanger the woolen fabric. It was found that, under proper working conditions, from 2 to 3 sq.ft. of filter area was sufficient thoroughly to clean 1 cu.ft. of gas per minute. The cleaned gases leaving the filter chamber contained no dust or fume that could be detected, even when viewed in a bright ray of light by means of a magnifying glass.

The baghouse contained twenty-four woolen bags, each 18 in. in diameter and 30 ft. long, and having a total filtering capacity of 75,000 to 80,000 cu.ft. of gas per hour at 80 deg. C. Unfortunately, at the time the baghouse was put into service, several rainy days occurred, followed by heavy fogs, during which time the atmospheric humidity averaged between 80 and 90 per cent. This resulted in excessive condensation of moisture on the woolen bags and prevented successful filtration of the gases. To overcome this condensation, the volume of gases treated was increased to 150,000 cu.ft. per hour so as to draw a greater amount of heat into the bag chamber and to elevate the temperature therein to a point sufficiently above the condensation temperature. This worked successfully, and splendid filtration was obtained. The temperature, however, continued to rise, and the volume of gases treated had to be correspondingly diminished. After ten days of satisfactory operation it was discovered that the bags were being rapidly destroyed, finally to the extent of being rent into numerous openings, thereby permitting the gases to pass through without cleaning. The baghouse was then opened and new bags were substituted for the old. At that time it was believed that the destruction of the bags was due to excessive moisture and too high temperature.

Sulphuric Acid Destroys Bags

Starting again with new bags, careful attention was paid to maintaining the temperatures of the gases within the baghouse to within the range of 80 to 100 deg., this being the working temperature range prescribed in practically all the successful baghouse installations in this country. But under these conditions the new bags lasted for only four days. Samples of the destroyed fabric were analyzed and found to contain zinc sulphite and basic zinc sulphate, and it was concluded that the action of moisture and sulphur dioxide, at the temperature existing in the baghouse, caused a form of hydrolysis of the zinc salts in contact with the woolen fabric, thereby liberating sulphur trioxide or sulphuric acid, which gradually decomposed the wool.

Experiments were then tried in introducing pulverized lime into the gas stream before entering the bags, but without successful results. It was subsequently found that the rapid deterioration of the bags was due to sulphur acids of variable constitution (principally thionic acids), and despite the neutralizing effect that might be expected from the considerable quantity of zinc oxide contained in the gases, together with the pulverized lime that was purposely added as a neutralizing agent, all efforts to prolong the life of the bags proved fruitless, and this method of cleaning the gases was abandoned.

Attention was next directed to the electrostatic method of precipitation as developed in the Cottrell process. A unit or "treater" of the tube type, consisting of twenty tubes or pipes, each 14 in. in diameter and 15 ft. long, designed to treat approximately 200,000 cu.ft. of gas per hour, was installed, together with the necessary electrical apparatus. This was one of the

first installations, if not the first installation, of this kind for cleaning gases to be subsequently used for other purposes and where the gases had to be kept undiluted by air; in other words, the conditions and requirements of the Ducktown installation were entirely different from those of any other installation in this country.

On account of the manner of operating the Cottrell process, it was necessary to support the high-voltage electrodes upon powerful dielectric insulators placed within the treater apparatus in such manner that they were at all times exposed to the corrosive action of the gases being treated.

The prime difficulty was due to condensation of sulphurous and sulphuric acids upon these insulators to such an extent that electrical leakages occurred, resulting in arcing over the insulators and consequent interruption of operations. Many expedients were tried to avoid these insulation failures, such as varying the temperature of the gases to control condensation of the acid vapors; inclosing the insulators in various ways, and placing them in different locations with respect to the gas flow. None of these proved entirely satisfactory.

Conditions Essential to Precipitation

The principal constituents of the fume are the zinc compounds, as has already been stated. These compounds are ordinarily present in an unsaturated condition in the blast-furnace gases. If the amount of such compounds in a given volume of gas is not sufficient to saturate the gas at the existing temperature, and subsequently the temperature is lowered by cooling, these compounds will not precipitate from the gas until a temperature is reached that represents the saturation point. Ordinarily, the requisite temperature (corresponding to such saturation point) is lower than the melting point or liquid phase of the compound, so that the substance is precipitated in a finely divided solid state—i.e., as *fume*. It is evident that with decreasing saturation, a correspondingly decreased temperature is required for sublimation, and in treating such zinc compounds as are found in the blast-furnace gases, the temperature must be reduced to practically atmospheric normal (20 deg. C.) before the last traces of zinc compounds can be removed.

If the gases are passed through the cleaning apparatus at a high temperature, it may be clearly seen that, with subsequent reduction of temperature, further sublimation will take place, and result in the formation of a "second crop" of fine fume, thereby defeating the very purpose of the cleaning apparatus. The Cottrell apparatus will not precipitate gases or compounds existing in the gaseous phase; the temperature must be reduced to the point where such compounds are condensed to the liquid or solid phase. This has been one of the difficult problems in the application of the Cottrell process, for the temperature of the gases must be sufficiently lowered to insure the sublimation of all volatile compounds, and with such reduction of temperature there is also condensed and precipitated the undesirable acid constituents of the gases which have so seriously interfered with electrical insulation.

Changes in Character of "Fume"

Another peculiar feature of more than passing interest was discovered in connection with the then inexplicable physical characteristics of the dry fume precipitated by the Cottrell treater. It has been mentioned that this fume was intended to be utilized in the manufacture of electrolytic zinc. It was found, however, that the electrically precipitated fume could not be leached; indeed, it persistently resisted every practical means of solution—the dry fume *could not be wetted* by water or any solvent that could be satisfactorily employed in relation to subsequent purification for use as a pure electrolyte. This fume, when placed in water, immediately floated to the surface, and continuous mechanical stirring for forty-eight hours failed to submerge or wet the particles.

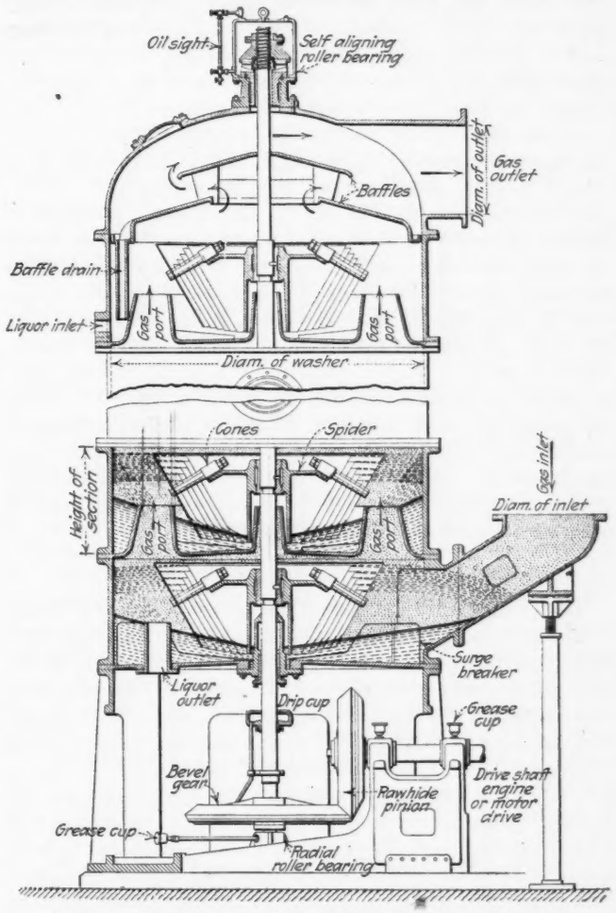


FIG. 1. GENERAL ARRANGEMENT OF THE FELD CENTRIFUGAL SCRUBBER

As a further experiment, samples of the fume were placed in a vessel and the water added therein was violently agitated by a stream of air (and later by live steam), but without success in wetting the particles. The only successful results were obtained by immersing the fume in a fairly strong sodium chloride brine, but this could not be employed, on account of the difficulty in eliminating the chloride that otherwise entered into the electrolyte. It was concluded, and later proved, that the impalpably fine particles of fume had adsorbed upon their surfaces considerable quantities of sulphur dioxide, and that water, or any other common solvent, at ordinary temperatures, was unable to displace the adsorbed films of gas. Only by subjecting the fume to high temperatures, or a preliminary roasting, could the fume be finally saturated with water sufficiently to effect solution.

The next experimental work was done with the Feld scrubber. This apparatus consists of a number of separate washing chambers, illustrated in Fig. 1, mounted one above the other. The ports or openings in

the bottom of each chamber act as passages for the ascending gas, as well as overflows for the counter-current flow of the scrubbing or absorbing liquid.

The vertical shaft suspended from a self-centering, anti-friction bearing is provided in each chamber with a series of concentric frustums of cones. The number of cones varies with the size of the apparatus. The spacing between the bottom of the chamber and the bottom of the cones increases toward the shell, to provide for their equable immersion in the scrubbing liquid, as well as to secure adequate agitation to avoid deposition of solids. Fig. 2 illustrates a typical cone assembly.

When the vertical shaft revolves, these cones pick up or pump the scrubbing medium, which is thrown horizontally with considerable velocity through the outer perforated distributing cone. Additional impetus is given the liquid at this point by the greater rim speed of the distributor, and the liquid is projected through the gas space in the form of a fine, high-velocity spray, which, upon impact with the shell, is broken into a mist or fog. This alternating humidifying and scrubbing effect to which the gas is subjected in each chamber provides the intimacy of contact between gas and liquid necessary for the removal of finely divided insoluble matter or for the recovery of soluble constituents existent in extreme dilution, and also provides for the almost universal application of the apparatus as a scrubber as well as a reaction or absorption tower.

Principle Governing Scrubber's Efficiency

The effective utilization of the entire volume of scrubbing medium, as compared with the problematical contact in scrubbers of the grid type, or those in which the gas passes over wetted surfaces, can be realized by a consideration of the infinite number of smaller drops into which the normal globule is broken, as compared with the other types mentioned. A globule $\frac{1}{10}$ in. in diameter, broken up into drops having a diameter of $\frac{1}{100}$ in., would produce 1,000 of the smaller particles and would present ten times the original liquid surface to the gas stream. This increase in the amount of surface presented per unit volume of liquid assures greater penetration and consequent absorption of the soluble vapor constituents, and, if solids are present in the gas, enables such particles to be thoroughly emulsified by the scrubbing medium. This factor is enhanced by the number of liquid contacts, or recirculations, that take place in the counter-current flow through the apparatus. The number of contacts per unit volume of liquid varies with the service, ranging from a minimum of twenty-five per minute in physical service to a maximum of three hundred per minute in some chemical services.

These factors, responsible for the effective utilization of the liquid, enable the use of smaller volumes of scrubbing medium, thereby securing higher concentration of the effluent. In continuous operations, where liquid recirculation is practiced, marked economy in installation costs and power consumption is effected, owing to the smaller volumes of circulating liquid needed.

The vigorous liquid agitation eliminates the possibility of internal stoppages, as has been demonstrated on scrubbers operating for several years using liquids carrying suspended, insoluble, reactive material. Any liquid entrainment is removed from the gas by means of the deflectors or baffles in the dome, and the collected liquid is returned through the drain to the top chamber.

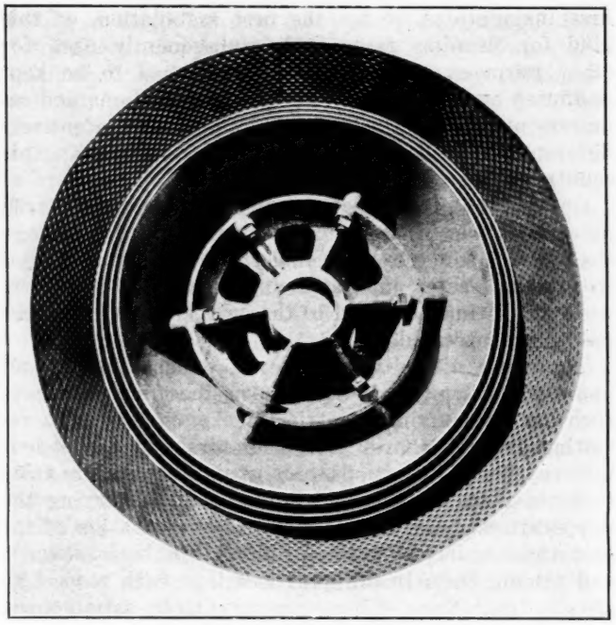


FIG. 2. A TYPICAL CONE ASSEMBLY IN THE FELD SCRUBBER

For primary washing, the Feld scrubber is ordinarily constructed with seven chambers or sections; the lower three being the washing chambers, the fourth one being a separating chamber and the upper three being the cooling chambers. The washing is accomplished mostly in the lower sections, whereas the upper sections perform primarily the function of cooling and dehumidifying the gas, all of the functions being subject to variation at will, depending upon the amount of gas passed through the scrubber and upon the volume and temperature of the scrubbing liquid used.

Apparatus Used at Ducktown

The Feld gas scrubber first used in the Ducktown experiments was a standard design 5-ft. diameter, seven-section machine, manufactured by the Bartlett-Hayward Co., of Baltimore. It was estimated to be capable of cleaning 200,000 to 250,000 cu.ft. of gas per hour and was driven by a 10-hp. motor. The capacity of this scrubber was much more than required for the purposes for which the gas was to be utilized—namely, the production of elemental sulphur. The cleaned gas was delivered to the sulphur-reduction furnace wherein the sulphur dioxide, by reaction with incandescent coke, was reduced to sulphur vapor and condensed as "flowers of sulphur." The reduction furnace was capable of treating 40,000 to 50,000 cu.ft. of gas per hour; therefore, in the initial experiments, this volume of smelter gases, containing about 7 per cent of sulphur dioxide, was delivered to the scrubber.

It should be noted here that one of the essential requirements in the successful operation of the sulphur reduction furnace was that the gas should be cleaned as thoroughly as possible; otherwise the coke became quickly coated with zinc compounds to such an extent that the reactions were greatly diminished and uncontrollable; furthermore the elemental sulphur produced under such conditions was contaminated with zinc sulphide (or polysulphides), rendering it unmarketable. Also, it was found important that the moisture content of the gases be kept as low as possible, to prevent the formation of hydrogen sulphide, which seriously inter-

fered with the reactions in the reduction furnace. These were some of the positive requirements placed upon the Feld scrubber, and it should be borne in mind that this was the first installation where this apparatus was employed for the cleaning of copper-smelter gases.

In the first trial, the scrubber was operated with a shaft speed of about 120 r.p.m. and with a flow of about 1,000 gal. of water recirculated through the scrubber per hour, but the gas did not appear to be perfectly cleaned, although a large amount of dust and fume was removed, as shown by the color of the wash water and by the steadily increasing amount of soluble zinc compounds as determined by analyses of the recirculated wash water. The cleaned gases contained less than 0.1 lb. of fume per 1,000 cu.ft., as compared with 2.1 lb. contained in the gas delivered to the scrubber—a recovery of approximately 95 per cent of the solid matter originally contained in the smelter gases. With this large volume of wash water, it was soon discovered that about 50 to 60 per cent of the sulphur dioxide contained in the entering gases was dissolved out or absorbed in the solution.

The next experiments were, therefore, devoted to reducing this absorption of the sulphur dioxide, and it was decided to discontinue the recirculation of the wash water, and to use only the amount of water necessary to reduce the temperature of the exit gases to the lowest attainable point, and correspondingly to permit the temperature of the outflowing wash water to rise to as high a point as permissible without incurring damage to the revolving lead cones of the washer. The shaft speed of the scrubber was also increased to 150 r.p.m.

The results of this experiment were immediately most encouraging, and it was soon found, with added experience, that the loss of absorbed sulphur dioxide could be reduced to a negligible amount, and the cleaning effect upon the gases was almost perfect. The extremely minute amount of fume that passed through the scrubber was invisible and the amount of water vapor present in the exit gases was little, if any, greater than the relative humidity of the outside atmosphere. The practical results attained through this degree of cleaning of the gases were evidenced by the fact that the elemental sulphur produced in the reduction furnace assayed as high as 99.2 per cent pure and contained less than 0.4 per cent zinc; whereas with the uncleaned gases, the zinc content in the recovered sulphur ran as high as 14 per cent.

Operating Results

To illustrate the practical results obtainable (on the basis of cleaning 50,000 cu.ft. of smelter gas per hour), the following data may be of interest:

TABLE I. OPERATING RESULTS

Scrubber Section	Gas Temperature Deg. C.	Water Temperature, Deg. C.	Absorption Volumes SO_2 per Volume of Water
Top	Exit	Enter	
No. 7	38	24	33
No. 6	40	25.5	32
No. 5	43	27.5	30
No. 4	46	30	28
No. 3	49.5	33	25
No. 2	54	37.5	22
No. 1	60	43	17
Bottom	Enter	Exit	

Sulphur dioxide in gases entering scrubber, 6.0 per cent by volume.
Sulphur dioxide in gases leaving scrubber, 5.25 per cent by volume.
Specific heat of smelter gases, 25 lb. calories per deg. C. per 1,000 cu.ft.
Solubility of SO_2 in water, 17 volumes SO_2 per volume of water, at 43 deg. C. (temperature of outlet water).
Wash water used, approximately 175 gal. per hour, or 3.5 gal. per 1,000 cu.ft. of gas.

Operating the scrubber with an outlet-water temperature of 95 to 100 deg. C., practically no sulphur dioxide remains in the outlet water, and apparently better gas-cleaning efficiency is obtained with the hotter water; but this practice is conducive to a greater content of water vapor in the exist gas. Therefore, it was found to be more practicable to work with colder wash water, and where the loss due to absorption of sulphur dioxide might otherwise be too high, the saturated wash water was recirculated with practically no loss of sulphur dioxide.

The scrubber runs continuously twenty-four hours per day without other attention than occasional oiling of the bearings, and has fulfilled every requirement of a gas-cleaning apparatus.

Condensation of Sulphur Vapor

Having solved the problem of cleaning the smelter gases for use in the sulphur-reduction furnace, experiments were next undertaken in the recovery of the elemental sulphur produced from these gases. For this purpose a second Feld scrubber, identically like the first, was installed.

These experiments were particularly interesting, as they developed not only the problems of fume precipitation but those of chemical absorption and reaction as well. That the reader may appreciate the broad scope of application of the Feld scrubber, it may be well first to explain the nature of the reactions in the sulphur-reduction furnace and something of the conditions to be met in the condensation of the elemental sulphur. As has been mentioned, the sulphur dioxide is reduced to elemental sulphur by reaction with incandescent coke maintained at a temperature of 1,100 to 1,300 deg. C. by the passage of electric current through the coke mass. The cleaned smelter gas contains normally 6 per cent sulphur dioxide, which reacts with carbon according to the following equations:

$$2SO_2 + 2C = 2CO_2 + S_2$$

or

$$2SO_2 + 4CO = 4CO_2 + S_2$$

Under these conditions, the sulphur vapor present in the exit gases has a partial vapor pressure of about 14 mm. (normal barometric pressure at Ducktown being about 725 mm.). This corresponds to a condensation temperature of about 255 deg. C., at which point sulphur vapor of this partial pressure begins to condense to liquid. Below this point the sulphur continues to condense as liquid until a temperature of 115 deg. C. is reached; corresponding to a partial vapor pressure of sulphur of about 0.03 mm. With a *slow rate of cooling* of the gases, at least 95 per cent of the sulphur vapor should be condensed in the liquid form; or if the temperature drops below 115 deg. C. and if the gases are not slowly cooled, the sulphur vapor passes directly into the solid phase and collects as "flowers of sulphur." More rapid cooling will result in the formation of fume of impalpable fineness.

Installing the Second Scrubber

Now, the sulphur-dioxide content of the smelter gases does not remain at all constant, varying between 5 and 10 per cent, because of irregular charging of the ores into the blast furnace and irregularities in the furnace blast. These fluctuations in sulphur-dioxide content, of course, result in corresponding fluctuations in the amount of sulphur produced in the sulphur-reduction furnace, and in the partial vapor pressures of the sul-

phur, necessitating constant adjustment of the temperature conditions for the condensation and recovery of the sulphur. Such control of temperatures and rate of cooling could not be adequately governed, and as a result the sulphur vapor often became super-cooled, with the attendant formation of fume. This fume was so finely divided that, when borne in the exit gases, it readily passed through eight thicknesses of closely woven handkerchief linen without obstruction. It was to collect this fume that the second Feld scrubber was installed.

In the first trial of this scrubber, it was soon discovered that successful recovery operations depended not only upon the performance of the washer itself but upon the physical condition of the elemental sulphur contained in the gases as they enter the washer. Various allotropic modifications of sulphur may be produced, both in the liquid and solid phases, and, as has already been explained, these modifications are governed by the temperatures, vapor pressures, and the time element existing throughout the period of their formation or transformation.

If the temperature of the gases entering the scrubber is too high, the sulphur will be precipitated in a more or less plastic form, which, according to the operatives' views, resembles scrambled eggs. The sulphur, when allowed to precipitate in this form, then tends to collect in masses, and these masses, after being rolled around in the scrubber sections and increasing in size, become lodged in the overflow pipes, causing obstructions, which prevent the circulation of the scrubbing liquor. If the temperature of the gases is too low, the sulphur appears in an almost colloidal form, rendering subsequent recovery from the scrubber liquor very difficult, if not almost impossible. The most desirable condition is the formation of a pseudo-crystalline variety, quite similar to the commonly known "flowers of sulphur." In this form the sulphur is readily removed from the scrubber liquor either by settling or by direct filtration. In either of these forms, however, the Feld scrubber removes the last visible trace of sulphur from the gases, and the only attention necessary is the occasional regulation of the flow of wash water (about 100 gal. per hour) and, of course, the replenishing of lubricants to the bearings.

Operating Difficulties

Occasionally irregularities occur in the operation of the reduction furnace, and carbon-oxysulphide or hydrogen sulphide are formed through over-reduction; at other times sulphur dioxide may escape reduction by passing through channels or pipes in the coke mass within the furnace; but in either instance, these compounds are entirely absorbed in the scrubber, and, reacting with the saturated solutions which circulate in counter flow against the gases, produce a milky-white colloidal solution of sulphur, which is immediately recognized by the operating attendant. The second scrubber thus affords all of the various indicative factors necessary to the practical control of reduction and condensation. With this correlation of reactions and positive control, the sulphur is collected in the condensation apparatus almost entirely in the form of "flowers," and the Feld scrubber is called upon to function as a gas-cleaning apparatus only when the temperature control is inadequate.

In a theoretical discussion of the principles involved in the successful removal of finely divided dust particles, or fume, from suspension in gases, it is necessary to know something of colloids and adsorption; for anyone familiar with metallurgical smoke will undoubtedly agree that the smoke is composed of particles possessing an extremely high degree of dispersion. And it is now generally conceded that all solids tend to adsorb, or condense, upon their surfaces films of gas or vapor from the atmosphere into which they are brought in contact. The amount of adsorption in any given case is dependent upon the nature and physical state of the solid and also upon the pressure and temperature of the gas; in general, with increase of pressure or decrease of temperature, adsorption is augmented.

Not only do solids adsorb gases, but adsorption phenomena may be found among any pair of gaseous, liquid or solid phases, provided the temperature and pressure conditions are favorable and one of the phases is existent in a sufficiently dispersed form. Adsorption is purely a surface phenomena and probably a manifestation of the forces of adhesion. An extremely subdivided phase possesses a relatively large surface compared with the mass of any substance, for the surface varies as the square of its unit measure, whereas the volume varies as the cube of that dimension.

Considering a cubic foot of any solid material subdivided into smaller cubes, or a cubic foot of any liquid subdivided into small spheres or drops, it may readily be seen how rapidly the number of particles and their aggregate areas increase. Thus a cube containing one cubic foot has an area of 6 sq.ft., whereas a sphere of the same volume has a diameter of approximately 14.89 in. and an area of 4.85 sq.ft.; and, by subdivision, the number of particles and their aggregate areas will be as follows:

TABLE II. SUBDIVISION OF CUBES AND SPHERES

Number of Particles, as Cubes	Number of Particles as Spheres	Diameter or Length of One Edge	Aggregate Area of Particles,
——Equivalent to One Cubic Foot——		Inch	Sq.Ft.
1,728	3,300	1.0	72
13,824	26,400	0.05	144
110,592	211,247	0.25	288
1,728,000	3,300,000	0.1	720
13,824,000	26,400,000	0.05	1,440
27,000,000	51,560,000	0.04	1,800
64,000,000	122,200,000	0.03	2,400
216,000,000	412,500,000	0.02	3,600
1,728,000,000	3,300,000,000	0.01	7,200

It will be noted that, comparatively, the aggregate areas of spheres and cubes is the same when the diameter of the sphere is taken equal to the length of one edge of the cube.

Now, as far as can be determined by most careful observation (for actual determination cannot be made), the spray produced by the revolving, perforated cones of the Feld scrubber is comparable with the finest mist particles. The peripheral velocity, or rim speed, of these cones is about 1,800 to 2,000 ft. per minute, and at this tangential velocity the scrubber liquor is projected through the gas space in the form of very fine spray, which, upon impact with the shell, is still further subdivided into a mist or fog.

According to the U. S. Weather Bureau, rain appears to begin when the drops reach a diameter of 0.04 mm. (0.0016 in.), and in Bentley's experiments on the size and frequency of raindrops, the following data were obtained:

TABLE III. SIZE OF RAINDROPS

Apparent Size of Drops	Diameter of Drops, Millimeter	Diameter of Drops, Inch
Very small	Under 0.8	Under 0.03
Small	0.8 to 1.5	0.03 to 0.059
Medium	1.6 to 3.5	0.063 to 0.137
Large	3.5 to 5.0	0.137 to 0.197
Very large	Over 5.0	Over 0.2

It is not an unreasonable estimate to place the average size of drop produced by the Feld scrubber as not exceeding 0.01 in. in diameter; therefore, as shown in Table II, each cubic foot of liquor atomized within the scrubber will produce about 3,300,000 liquid particles, having an aggregate area of 7,200 sq.ft. On this basis, it may prove interesting to calculate what intimacy of contact may be attained between these particles of liquid and the particles of fume carried by the gases in passing through the Feld scrubber.

Capacity of Feld Scrubber

A 5-ft. diameter seven-section Feld scrubber will clean approximately 200,000 cu.ft. of gas per hour (55.5 cu.ft. per sec.) and will require about 20 gal. (2.675 cu.ft.) of scrubbing liquor for each 1,000 cu.ft. of gas cleaned (or 0.002675 cu.ft. of liquor per cubic foot of gas). On the same basis, 1.1 gal. of scrubber liquor each second will be delivered to the scrubber. The gas space contained in a scrubber of this size is about 150 cu.ft., so that a unit volume of gas takes about 2.7 seconds' time in which to pass through the scrubber.

In each chamber or section of the scrubber, the liquor is picked up by the revolving cones, dashed into spray and mist, the latter coalesced and precipitated to the bottom of the chamber only, in turn to be picked up by the cones, and the cycle repeated in a period of about one-half second. Thus, by means of each set of cones, revolving with a peripheral velocity of 1,800 to 2,000 ft. per minute, about two gallons of liquor per second will be atomized, and as about one gallon of liquor is delivered to the scrubber each second, it will become atomized and coalesced approximately twice each second in each section of the scrubber, and, in the seven sections of the scrubber, this effect is attained fourteen times during each second the scrubber is in operation. Therefore, during the 2.7 seconds, in its passage through the scrubber, each cubic foot of gas will be penetrated by $2.7 \times 14 \times 0.00267 \times 3{,}300{,}000{,}000 =$ approximately 333,679,500 particles of scrubber liquor.

One cubic foot of Ducktown fume in a compressed (or solid) state weighs approximately 312.5 lb. Each 1,000 cu.ft. of smelter gas contains about 2.2 lb. of fume, or 0.0022 lb. of fume per cubic foot of gas, or a volumetric equivalent of 0.00000705 cu.ft. of fume. Suppose all the fume will pass through a 200-mesh screen: the fume particles will have a diameter of approximately 0.00236 in. The number of particles can be computed from the formula:

$$n = \frac{6 \times V \times 1728}{d^3}$$

where

$n =$ *number of particles,*
$V =$ *volume of original mass in cubic feet,*
$d =$ *diameter of particles in inches.*

Substituting:

$$n = \frac{6 \times 0.00000705 \times 1728}{0.00236 \times 0.00236 \times 0.00236}$$

$= 5{,}620{,}000$ *particles of fume per cubic foot of smelter gas.*

From the above, it will be seen that the ratio of liquor particles to fume particles is 333,679,500 to 5,620,000, or about 60 to 1. Therefore, each particle of fume is exposed to contact with sixty particles of liquid during its passage through the scrubber, and, during its long and circuitous course of travel in the midst of the cyclonic swirling of the gases, it is almost impossible for a particle of any substance to escape repeated contacts with the atomized scrubber liquor.

The volumes of flow of both the gas and the liquor are at all times under control and can be varied and relatively proportioned to meet operating conditions within the rated capacity of the scrubber. The wonderful effectiveness and efficiency of the Feld scrubber, as a gas-cleaning apparatus, may thus be measurably appreciated.

Effect of Ionic Attraction

Now to return again to more theoretical considerations: It may readily be shown by experiment that when drops of water are broken up (as in falling raindrops, or by atomizing water by means of spray nozzles), the particles become positively charged with electricity. The positively charged particles condense more readily on negatively charged particles or on negative ions than they do on positively charged particles, and, also, liquid drops take up negatively charged particles or ions more readily than positive ones.

When dust is blown about by the wind, it becomes charged electrically, and from experiments made by Rudge, the following generalizations were deduced:

1. Non-metallic elements give *positively* charged clouds when the finely divided solid material is blown into a cloud by a current of air.
2. In similar manner, metallic elements give *negatively* charged clouds.
3. Solid acid-forming oxides give *positively* charged clouds.
4. Basic oxides give *negatively* charged clouds.

In the treatment of material containing or constituting salts, the charge apparently depends on the relative strength of adsorption of positive and negative ions.

Finely divided metallic sulphides generally acquire a positive charge, but the metallic oxides, sulphates, and sulphites acquire negative charges. In general, it has been found that highly dispersed substances, suspended either in gases or liquids, carry electrical charges, and this is particularly true of colloidal and ionized substances. It may be stated that, as a rule, basic colloids acquire negative charges, whereas acid colloids acquire positive charges.

Ralston's Conclusions

Ralston states that "the amount and sign of the electric charge on a suspended particle depends entirely on the composition of the solution in which it is contained, so that it is possible to make this charge either positive, negative, or zero, by the use of proper proportions of the proper electrolytes." The same conditions are found to be generally true in the case of finely subdivided particles in suspension in gases, and for the same reason—namely, the minute particles exhibit all of the phenomena associated with adsorption; they acquire surface films derived from the preponderant free ion present in the fluid (either liquid or gaseous) in which the particles are suspended, and, in metallurgical smoke, the particles are usually *negatively* charged.

Bivalent compounds or substances appear to acquire relatively higher electrical charges than monovalent compounds, and trivalent compounds carry even higher charges; the higher the valence of the cation, the greater will be the electrical charge-carrying capacity; therefore, polyvalent compounds, or rather ions, such as the ferrocyanides, ferricyanides, phosphates, and

thionates, are found to carry the highest charges, and the cations of these salts are found to be very easily recovered in the Feld scrubber.

Laws That Govern Flocculation and Precipitation

The relationship between adsorbed films and the accumulation of electrical charges upon the surfaces of minute particles is undoubtedly a most intimate one; indeed, it may be said that the one is more or less dependent upon the other. The extensive research work that has been done in connection with the study of the flocculation and deflocculation of slimes and the coagulation of colloidal solutions all seems to lead to the same conclusion, and it may be further stated that those conditions which favor flocculation of slimes and precipitation of colloids also favor the precipitation and removal of fume particles from gases. Each particular case will generally be found to possess some particularly individual characteristics, but the general analogies will hold throughout. In the flocculation of slimes, one has to deal with finely divided or colloidal particles suspended in liquids; with fume, one has the same characteristically minute particles of matter suspended in gases.

If an electrically charged solid particle is free to move, as is the fume particle suspended in the gas-stream, it will be attracted to any particle or body that is oppositely charged, and will move at a rate proportional to its charge or the potential difference between the particles, the force of attraction varying inversely as the square of the distance between the particles. Of course, the electric charges borne by the particles are very small, but they are, nevertheless, of sufficient magnitude to develop a force of attraction between oppositely charged particles, or a force of repulsion between particles having like charges; provided that any two of the particles are brought within their radii of action.

Forces Affecting Operation of Scrubber

The forces effective in the operation of a Feld scrubber may now be considered. The spray or mist particles produced in the scrubber are *positively* charged, whereas the particles of fume contained in the smelter gases are *negatively* charged, and, all the physical conditions being such that these oppositely charged particles are brought into most intimate contact, the result is that these particles are mutually attracted and the fume particles are wetted and submerged within the liquid and thus removed from the gas stream.

The various factors and calculations adduced in explanation of the functioning of the Feld scrubber in cleaning metallurgical smoke afford interesting studies that may be applied to various individual services, either in the scrubbing of industrial gases or in its use as a reaction tower for the conduct of chemical operations.

Its operating results would indicate that former failures in the wet treatment of fume were due to inherent faults in the apparatus employed, and are proof of the efficacy of water scrubbing when the essential intimacy of contact between gases and liquid is actually assured.

The combination of the various desirable features mentioned, together with its simplicity of installation and operation, make the Feld scrubber an apparatus that should attract the consideration of the metallurgical industry as a whole.

Production of the French Bauxite Mines

The increase in the production of the French bauxite mines has followed closely the development of the aluminum industry, according to Ernest L. Ives, Consul at Paris, in *Commerce Reports*. From 21,707 metric tons of bauxite extracted in France in 1890 the production increased to 309,294 metric tons in 1913. In this amount the various producing regions were represented as follows: Var, 258,074 metric tons; Herault, 43,800 tons; Bouches-du-Rhone, 4,270 tons; Ariege, 3,150 tons.

During the same year the world's production of bauxite was given as follows: France, 309,294 metric tons; United States, 213,605 tons; Italy, 6,952 tons; England, 6,153 tons. Therefore, previous to 1914 the French production represented about 58 per cent of the world's production of bauxite, and the production of the United States represented 40 per cent.

The war greatly modified the situation. From the beginning of hostilities France was obliged to limit its exports and consumption, and also the production of its bauxite mines. In 1915 the production amounted to only 56,522 metric tons; in 1916, 106,200 tons; in 1917, 120,916 tons, or about one-third of the peace-time production. Of this amount 101,748 tons was suitable for the production of aluminum.

In contrast, extraction in the United States increased from 297,041 tons in 1915 to 568,690 tons in 1917. Since that time French production went up noticeably, and it is reported to have reached 160,685 tons in 1919. However, the present economic crisis has also affected the aluminum industry.

In 1913, when the bauxite production of other countries was insufficient to cover their needs, France consumed 141,729 metric tons and was able to export over half of its production, or 168,439 metric tons, which was shipped principally to the following countries: The Netherlands, 51,333 metric tons; England, 49,695 metric tons; Germany, 31,156 metric tons; United States, 12,173 metric tons; Belgium, 10,980 metric tons; and Switzerland, 1,823 metric tons. Before the war France supplied bauxite to the principal markets. It was, however, losing the United States market, the exports to which decreased from 33,189 metric tons in 1911 to 12,173 metric tons in 1913.

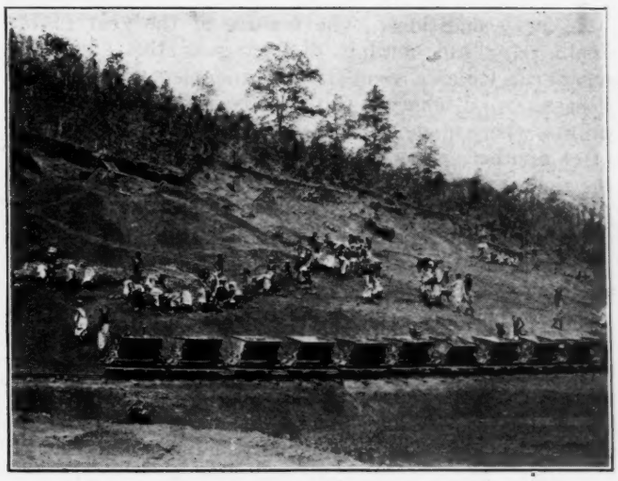
This situation could not be maintained during the war. As early as 1915 France exported only 41,448 metric tons of bauxite, or one-fourth of the 1913 exports. This tonnage increased to 62,802 metric tons in 1916, but decreased to 39,341 metric tons in 1919. The following year saw a considerable increase in French exports of bauxite, which amounted to 130,031 metric tons, over 80,000 metric tons of which went to England and about 30,000 metric tons to the United States. England thus became the chief importer of French bauxite.

According to reliable opinions, it is thought that the French production of aluminum is likely to increase from 25,000 to 30,000 metric tons, as compared to 13,500 metric tons in 1913. The probable French consumption of bauxite might then be about 200,000 metric tons per year. This, however, is a purely approximate figure and its realization might be far off if the present economic situation continues.

The French mines, which produced over 300,000 metric tons of bauxite before the war, will be in a position to fill the needs of the national industry, and there will still remain a large exportable surplus.

Iron Mining in India—Tata Iron & Steel Co.

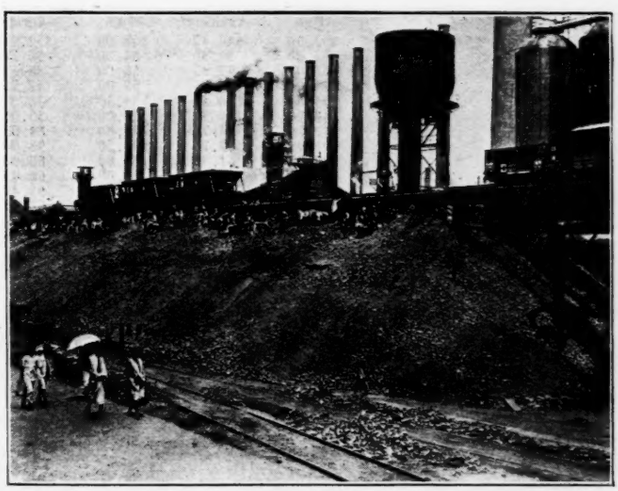
MINING A RICH POCKET OF FLOAT, GORUMAHISANI MINE



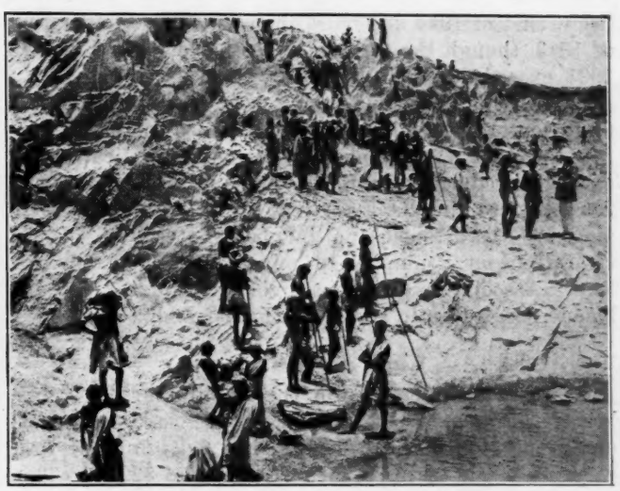
LOADING IRON ORE, STOCKPILED AT MINE

LOADING ORE INTO CARS, OR "TUBS"

SCREENING FLOAT ORE AT GORUMAHISANI MINE



STOCKED IRON ORE AT JAMSHEDPUR FURNACES



HAND DRILLING IN DOLOMITE QUARRY

The Joplin District in 1921

BY JESSE A. ZOOK
Written for *Engineering and Mining Journal*

THE year 1921 was one of retrenchment in readjustment of the mining business to accommodate new conditions. The feature of the year in the Joplin zinc-lead mining district was the admirable manner in which a complete rearrangement was effected. Losses were discharged to that account, and the meager profits, where made, were accepted as a gift. Mines, one after another, were closed down, until only those with the richest ore deposits could afford to operate, and even these would have failed to produce a profit with any class of labor other than the wholly American element employed in this district. Men accepted, one after another, the necessary wage reductions and even gave more of themselves in order to keep in operation the few mines able to withstand the shock. Mine owners and miners gave of their substance, by donations to a permanent road improvement fund, to aid miners finding no mine employment. There were instances of want but none of distress, many being cared for by individuals and organizations contributing to funds and finding employment at odd jobs for those in need. "Find something for men to do" was the policy pursued, which was a greater aid than letting men be obliged to ask for charity.

The output of Oklahoma was all from Ottawa County and of Kansas from Cherokee County. Of the total Missouri shipment all but 1,214,780 lb. of blende, 120,860 lb. of calamine, and 49,880 lb. of lead was produced in Jasper County, the tonnage excepted being the contribution from Newton County. No other county in southwest Missouri made ore shipments through purchasing agents in this district.

Newton County, with over 8,000 tons of calamine shipped in 1920, found a market for only 60 tons last year. Greene, Ozark and Barry counties gave out some mineral wealth in 1920 but none in 1921. Arkansas, with little in 1920, reported less in 1921.

Readjustment lost to the Joplin district, according to 1921 valuation standards, almost $25,000,000. The decrease was 245,000 tons of blende, 10,075 tons of calamine, and 23,581 tons of lead. According to pre-war standards, the 1921 valuation is almost $2,000,000 below that of 1914 and more than $4,000,000 under that of 1913, though the tonnage of both blende and lead in 1921 exceeded either of those years.

The average weekly shipment of blende in 1921 was 6,118 tons. Stocks in bins at the mines increased during the year 12,000, or 231 per week, indicating an average production of 6,349 tons per week. Demand for lead ore, in disproportion to its occurrence with zinc ore, occasioned the increased stock of blende. Operations at a number of mines were primarily for lead. Association of the two ores accounted for the blende production in excess of the demand.

PRICES

The blende in demand for the manufacture of Prime Western grades of slab zinc began the year on a basis of $29 per ton of 60 per cent zinc, declining the first week to $27.50 and in the fourth week to $22.50. This level held, with the exception of $21 the first week of March, until in the third week of April it was advanced to $25 for four weeks. In mid-May it dropped back to $22.50 and to $21 on the first and $20 at the end of June, holding this level to the last week in August, when for two weeks a considerable tonnage was purchased on a $19 basis. The end of September reinstated the price level to $21. In October it was $22.50, $25, and $23. Throughout November a $25 basis prevailed, at which figure 30,000 tons of reserve stock was sold to avoid an Oklahoma taxation of $2 to $3 per ton. December opened with $26 and closed with $29 basis, re-establishing the opening quotation of the year. Grades of blende used in the manufacture of sheet zinc sold during a large part of 1921 on a like basis with Prime Western, on account of the restriction of production of sheet zinc while the market was absorbing war stocks.

Following the period when the greatest record price ever attained for zinc calamine was reached in 1920, the demand for this product entirely disappeared, except for a few transactions in mid-year on a $10 to $12 basis for 40 per cent zinc, a price so low that all production was suspended.

Lead concentrates were on $55 basis for 80 per cent lead at the beginning of 1921, declining to $50 on the first and to $35 at the end of February, continuing to mid-March, when it advanced to $40 on the upward trend to $60 in mid-May, then declining steadily to $40 by the end of June. The reaction following sent it as steadily upward to $60 at the end of September, dropping to $55 at the end of October and to $53.50 at the end of November, when it was advanced by renewed demand to $54, and closed the year at $58.

SHIPMENTS OF ZINC BLENDE, CALAMINE AND LEAD IN THE JOPLIN DISTRICT, 1921, WITH VALUES

	Blende, Pounds	Calamine, Pounds	Lead, Pounds	Value
Oklahoma	467,630,340	.....	100,656,500	$8,133,330
Kansas	131,103,170	.....	27,928,610	2,327,280
Missouri	38,801,150	120,860	2,761,230	565,250
1921 Total	637,534,660	120,860	131,346,340	$11,025,860
1920	1,127,532,560	20,271,740	178,508,930	35,619,560
Decrease	489,997,900	20,150,880	47,162,590	$24,593,700

ORE PRICES IN THE JOPLIN DISTRICT FOR TWELVE YEARS

Per Ton of 2,000 Pounds

	Zinc		Lead	
	High	Average	High	Average
1910	$52.00	$40.42	$58.00	$51.98
1911	51.00	39.90	64.00	56.76
1912	67.00	53.33	68.00	56.60
1913	59.00	42.26	58.00	52.52
1914	54.00	40.46	54.50	46.55
1915	138.90	79.30	80.00	55.08
1916	131.70	84.72	104.80	84.07
1917	101.95	67.70	135.50	98.00
1918	78.70	51.33	106.00	88.98
1919	57.60	43.08	89.00	66.43
1920	61.50	46.49	112.50	95.40
1921	36.85	24.49	65.20	51.92

MONTHLY AVERAGE PRICES OF BLENDE, CALAMINE AND LEAD IN 1921, IN THE JOPLIN DISTRICT

Per Ton of 2,000 Pounds

	Blende	Calamine	All Zinc Ores	Lead
January	$31.46	.....	.....	$49.47
February	25.86	.....	.....	47.02
March	22.89	$16.00	$22.86	45.51
April	22.90	10.00	22.89	44.98
May	23.88	15.10	23.41	56.19
June	23.78	.....	.....	48.17
July	21.96	.....	.....	44.97
August	21.67	.....	.....	49.61
September	22.56	.....	.....	53.56
October	22.74	.....	.....	59.65
November	24.35	.....	.....	58.82
December	25.96	.....	.....	56.99
Year	$24.49	$14.03	$23.77	$51.92

The Calumet & Arizona

Deepest Level Most Promising of Those Opened So Far—Copper Occurs In Lenticular Masses—Ore Is Direct Smelting, Requiring No Milling

BY JAMES H. MCCLINTOCK
Written for *Engineering and Mining Journal*

TO THE WESTWARD of Bisbee, barely outcropping at several points, is a modest showing of quartzite, lying just below limestone. Save among district geologists, this quartzite is not given proper honor. In fact, it is the flooring of the district, bearing upon it the limestone within which have been and are being found the wonderful copper orebodies for which Bisbee has world-wide fame. From its surface showing above Bisbee it runs deeper and deeper to the eastward, until at the Campbell shaft of the Calumet & Arizona the steady 15 per cent dip is expected to give ore down to 4,000 ft. Without doubt, there remains 700 ft. more of stoping ground below the present bottoming of Calumet & Arizona's Junction shaft, which has its sump down to 2,350 ft., this being the deepest in the district. This statement, if properly digested, may give the reader an idea that Bisbee will be a thriving camp long after the demise of the men now operating its mines.

The Calumet & Arizona for ten years has been dropping its "center of gravity" just 11 ft. a year. By this expression is meant the mean depth of ore-stoping operations. This center is now below the 1,500 level. In reality, the lowest mining work is along the 1,800 level of the Junction, with 1,200 ft. yet to be explored below to the expected bottoming of the matrix limestone. It should be stated here that whereas ore was found in the company's uppermost mine, the Irish Mag, at 450 ft., the Junction shaft went through about 700 ft. of barren ground before striking pay rock. Yet in that same shaft was exhibited the very unusual feature of cutting two orebodies, one below the other. The first was 50 ft. thick at 900 ft. depth and the other 30 ft. at 1,800 ft. On this last level have been found three orebodies of high-grade ore. Indeed, according to the assistant general manager, I. B. Joralemon, more ore is likely to be developed on this 1,800 level than on any other of the mine. As yet the 1,600 level is by far the biggest ore producer.

It should be explained that the limestone is far from being uniformly impregnated. The copper occurs in lenticular masses, the longest of which, in the Calumet & Arizona, was about 500 ft. in extreme dimension. New bodies are found by exploratory drifting, usually along seams or leaders that are readily recognized by the experienced miners. Yet thousands of feet of work of this sort has been done in the district without result. The only surface copper ore ever found in the district was at the famous Glory Hole, just above the business section of Bisbee. Thence the ore is found at greater and greater depths. Irish Mag bottomed in the quartzite at 1,350 ft.

The average of the ores of the Calumet & Arizona is 5 per cent copper, though still richer ores are coming from the lower levels, where the product is singularly "brassy" chalcopyrite and bornite, so heavy that only 8 cu.ft. are required to make a ton. It averages at least 35 per cent sulphur, with occasional rise to 44 per cent. At the smelter this excess sulphur is eliminated by roasting down to 7 per cent. Little silica is found anywhere on the property. At one time there was exchange of heavy sulphides for the siliceous ores of the Old Dominion at Globe, but this had to be suspended when freight rates rose. On this account, for siliceous ores, the purchase of the Eighty-five mine, near Lordsburg, N. M., was made.

Calumet & Arizona has a total holding of 2,300 acres, rather generally in the zone of ore probability. Of this only 230 acres has been explored. So, laterally, as well as with depth, there is much ground for development.

Some day the Campbell shaft will be the main opening of the Calumet & Arizona. It now is 1,700 ft. deep, and connects with the Junction, about 2,500 ft. distant, on the 13th, 14th and 16th levels. Work on the Campbell has been suspended until completion of a new drift on the Junction 1,800 level, this to drain the new shaft. As soon as the Campbell concreting is finished to the 1,700 level sinking will be resumed to 2,300 ft., probably the base depth for many years to come.

Junction, the main shaft today, is to have concrete work continued down to 2,300 ft., but with its lowest working level at 2,200 ft., leaving the sump below for skip clearance and other needs. A great pump station is to be placed at the 2,200 level, raising water to the surface in one great lift, at a pressure of over 900 lb. per sq.in. The pumps are now lifting a steady flow of 3,300 gal. a minute, at a cost of over $25,000 a month. If the pumping were to be considered as a single item, and not in connection with the general work, the expense probably would be double this sum. The Junction pumps for the whole mining basin, this work continuing in the present slack period just as in the busiest of times. The only other pumps operated are on highly acid water at the Copper Queen's Czar shaft, the handling of which requires special equipment.

Ore has been developed in the Bisbee district over an area that is two and one-half miles from north to south and two miles wide. Its western limitation is believed to be known, but its eastern extension is merely guesswork. On the northeast, the Dividend fault cuts it off.

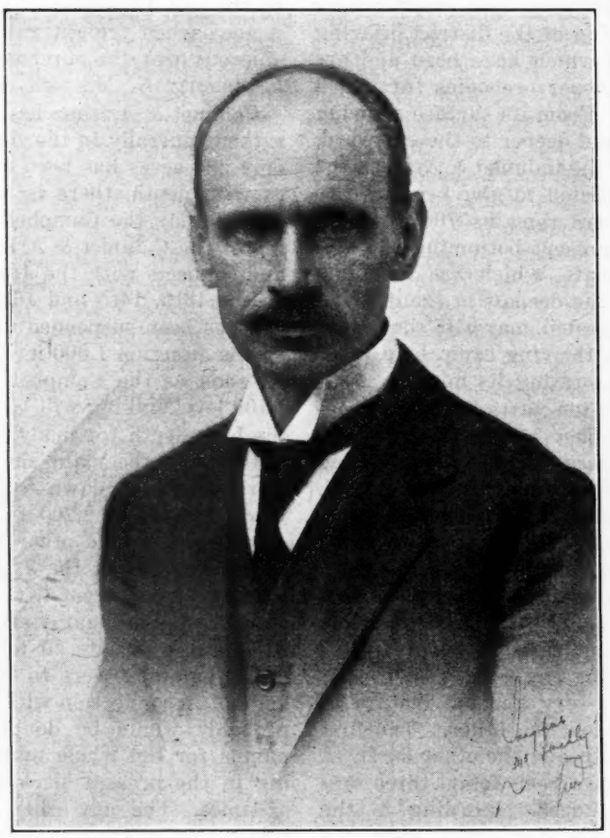
Calumet & Arizona is now continuing development work only from the Junction and Briggs shafts. It is remarkable as one of the few Arizona mines that handles a single class of ore by a single simple reduction process; that of straight smelting and of matte bessemerizing. The company owns no concentrator and needs none. It also has little oxide or carbonate ores. Ores now worked are primary in character. The company has a modern and efficient smelting plant at Douglas, and a sulphuric-acid plant, designed primarily to provide for the needs of the leaching tanks of the New Cornelia.

Calumet & Arizona is under the general management of John C. Greenway, once a lieutenant of Rough Riders and in the Great War a distinguished and much honored soldier, who rose to regimental command. His activities also include the operations of the Calumet & Arizona subsidiary, the New Cornelia, at Ajo

Mining Engineers of Note

Samuel John Truscott

SAMUEL JOHN TRUSCOTT, now of London, has seen nothing of American mining, but he has, nevertheless, observed a good bit more of mining throughout the world than falls to the lot of the average engineer. Born at Fowey, in Cornwall, in 1870, he early caught the mining spirit among the mines of Cornwall. Entering the Royal School of Mines in 1886 he was graduated in 1889. His first position was an interesting and adventurous one in far-off Singapore—which is not so strange, considering the great fondness of Britishers for travel and adventure in foreign lands and the mining engineer's tendency to work in odd corners of the earth—with a firm of mining engineers who placed him successively as assayer for a gold mine in the Malay States, manager of an alluvial tin mine, surveyor in the location of a government trunk road, and explorer of a ruby mine in Siam. He was once involved in a native rebellion and lost house and equipment. The jungle of that day has given way to the modern rubber plantation or has been removed to expose valuable tin deposits. "My sojourn was too early for these developments, nor could I foresee them," says Mr. Truscott. On his way home in 1892 Mr. Truscott visited Japan, and particularly the Ashio copper mines. Traveling through Canada down to New York, he proceeded to England. Again he took to the outskirts of civilization, passing through Johannesburg to an appointment in the romantic Lydenburg district of the Transvaal. Kopje, and veldt, kraal and sunshine are now his pleasant remembrance of that experience. It was not long, however, before the Witwatersrand absorbed him, and in succession he served as assayer, sampler, and finally engineer with John Hays Hammond and H. H. Webb, being in South Africa during the stirring times of the Boer war. The work with Hammond extended over the period during which that engineer was in a Pretoria prison in company with Rhodes, Farrar, and Fitzpatrick under sentence of death for participation in the famous Jameson raid. The mine of which he was then manager, the Nigel Deep, was naturally shut down. His stay in Johannesburg brought him into pleasant contact with Pope Yeatman, H. Hellman, and many other Americans. Striking out for himself, Mr. Truscott gave up the connection established in South Africa and returned to England to publish an accumulation of technical notes. This work finished, he went to the Ural Mountains of Russia on a reconnaissance associated with Hammond. Little resulted from this visit, as the important copper mines now known in that district were not then appreciated; their value is the creation of arts of mining and dressing subsequently developed. The head-hunting Dyaks and the orang-utan were his next neighbors on a year's exploration of Central Borneo. Then he became manager of a gold-silver mine in a beautiful part of the northern arm of the irregularly shaped island of Celebes. Here again he became involved in native trouble necessitating military relief. He afterward was made leader of an exploring party on the Ivory Coast of West Africa, and in 1902 returned to the Rand, but, receiving an attractive offer to assume the management of an important gold-silver mine in Sumatra, he accepted it and remained there until the successful results of his efforts made it possible for him to think of retiring. Later in London Mr. Truscott occupied himself as consulting engineer to interests in the Dutch East Indies, was an anonymous contributor of London items to *Engineering and Mining Journal* and during a short absence of T. A. Rickard acted as editor of the *Mining Magazine*. He is a member of the council of the Institution of Mining and Metallurgy, and of the A.I.M.E. He has written a book on "The Witwatersrand Goldfields: Banket and Mining Practice," and a translation of "Ore Deposits," by Beyschag, Vogt, and Crush.



SAMUEL JOHN TRUSCOTT

Mr. Truscott entertains a high regard for the American technical press, having recently written: "Were it not for the excellent technical periodicals of your country, the fact that I have seen nothing of American mining would stamp me as lopsided. But your periodicals are so good, and I have read them so assiduously, that I may fairly claim to have a balanced view of my subject. I look forward, however, shortly to acquire information and inspiration by an actual visit to the United States."

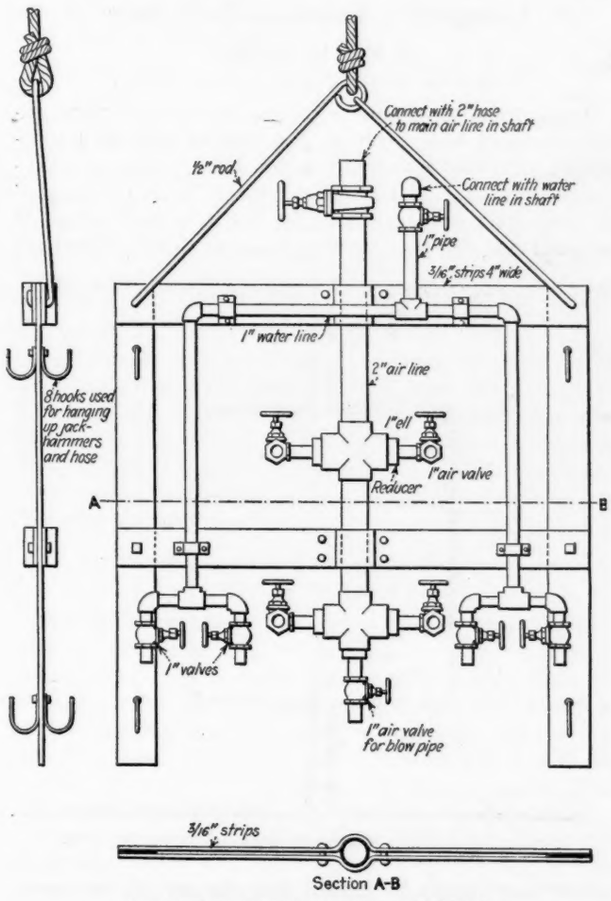
HANDY KNOWLEDGE

Drill Rigging for Shaft Sinking

BY M. J. ELSING

Written for *Engineering and Mining Journal*

A drill rigging is used to some extent for shaft sinking in the Southwest and has given considerable satisfaction. After the last bucket of muck has been hoisted, the rigging, which is shown in the accompanying sketch, is lowered from the surface and hung from the last timbers in the shaft at a height convenient for drilling. One air and one water connection is made,



SHAFT SINKING DRILL RIGGING

after which drilling can be immediately started. The individual drills are all connected and are hung on the different hooks ready for immediate operation when they are needed.

The rigging can be made in any blacksmith shop. The equipment consists of ordinary air and water pipe, reducers, street ells, and valves. All are assembled more or less as shown in the sketch. The hooks should be sufficiently large to hang a drill on, as well as several coils of hose.

The rigging, as shown, consists of connections for air and water for four drills and also a connection for a blow pipe at the bottom. It is a simple matter to make it for six or seven drills, if desired. It is always well to have an extra drill or two to replace one that may get out of order.

When the round is completed, the men hang the drills on the hooks and the rigging is hoisted to the surface, where it remains until it is needed for the next round. Defective hose or drills are replaced and everything is put in good order for the next round. The time that can be saved by the use of this simple device is surprising. Every shaft crew that has tried it in this district has indorsed it enthusiastically.

Bolt and Nut Trays

BY DONALD M. LIDDELL

Written for *Engineering and Mining Journal*

In a mill that I recently visited the master mechanic had taken a lot of old elevator buckets and nailed them against the wall to hold the various sizes of bolts, nuts and washers for which there was constant use. A small hole had been bored in the bottom of each bucket, so that if water accidentally got in it would run out. Small-size buckets were used for the small-size hardware and big buckets for the large. The wedge shape of the buckets makes it possible to put them closer together and to get into them more conveniently than any other form of tray that I have seen.

Pre-Heating Air for Reverberatory Furnaces

BY N. L. STEWART

Written for *Engineering and Mining Journal*

A great many smelter men have considered pre-heating air for reverberatory furnaces. Of course, in many plants it would not be desirable to utilize the waste heat in heating air, but where electric power can be purchased at a reasonable figure it might be more economical to use the waste heat in this manner than for generating steam.

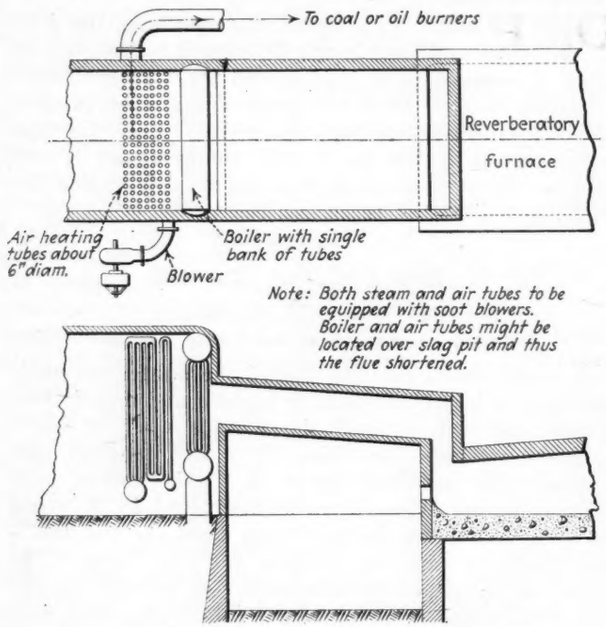
The stumbling block generally has been the flue dust. If checker work or tubes were used, it was difficult to keep them clean.[1] It has been demonstrated recently, however, that waste-heat boilers can be kept clean with soot blowers, and therefore it is reasonable to suppose that pre-heating tubes could be cleaned in a similar manner. It is proposed to pass the gases first through a small set of boiler tubes, and afterward through a large set of air-heating tubes.

With the arrangement shown in the accompanying sketch the small number of steam tubes would stop all molten flue dust and chill the gases enough to prevent burning out the air-heating tubes. The small amount of steam produced could be used for blowing the tubes and for heating buildings around the plant. Also, the blower might be driven by a steam turbine instead of a motor. The location of the soot blowers is not indicated. The proper number and location might have to be determined by trial.

The following assumptions were made: Air raised 500 deg. F. above atmospheric temperature; a reverbera-

[1] *Engineering and Mining Journal*, July 16, 1921, p. 101.

tory furnace requires 100 tons of coal per twenty-four hours, which, at 100 cu.ft. of air per lb. of coal, requires 13,800 cu.ft. of air per minute at atmospheric temperature (a small amount of air would leak through the brickwork); velocity in air tubes about 3,000 ft. per minute; heat transfer 0.03 B.t.u. per minute per sq.ft. per degree difference in temperature. This would require 4,100 sq.ft. of heating surface, or 135 pipes 6 in.


To coal or oil burners
Reverberatory
furnace
Air heating tubes about 6" diam.
Boiler with single bank of tubes
Blower
Note: Both steam and air tubes to be equipped with soot blowers. Boiler and air tubes might be located over slag pit and thus the flue shortened.

ARRANGEMENT FOR PRE-HEATING AIR FOR REVERBERATORY FURNACES

in diameter and 20 ft. long; about 110,000 lb. of heating tubes, costing approximately $12,000.

It should be noted that the air is shown as going up one set of tubes, down another, up two sets of tubes and down three. This allows for expansion of the air.

When using pre-heated air in a reverberatory it would be necessary to close the firing end of the furnace tightly. If this tended to burn out the end wall, it might be necessary to replace the wall with a water jacket. Judging by the above stated figures, the cost of such an installation should not be prohibitive.

Pulling Rope for Locomotives

By H. H. Hunner

Written for *Engineering and Mining Journal*

Breaking in or pounding down a new track over fresh fills and a soft roadbed with modern big equipment is conducive to numerous "spills." If one is trying to keep a 300-ton shovel busy digging earth at the same time, something speedy is needed as a re-railing aid. The following method of using a pulling rope in conjunction with a re-railing frog was devised by George Leibig, pit foreman for the Cornwall Ore Bank Co., of Cornwall, Pa.:

The rope may be cut from old hoisting rope and should be about 1¼ in. in diameter and 25 ft. long. Tie or clamp one end of the rope to a hook and the other to a coupling link. If tied, the first pull of the locomotive will make a never-slip knot. It is also easier and quicker to re-tie the rope than to change cable clamps if a tear occurs.

The section ahead of a derailed truck is uncoupled and the link end of the rope attached to this. The hook is caught in the truck frame back of the journal box on the side which will draw the wheels to the track. After the wheels are pulled close to the rails, the replacing frogs are used along with the rope. The side pull of the rope on the truck crowds the wheels to the rails and counteracts the overturning effect of a loaded car on the frogs.

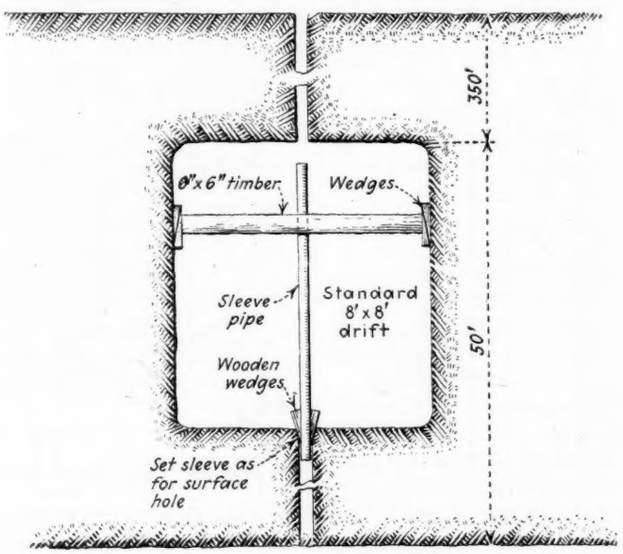
Warped "A" frogs can be used and need not be blocked up or fastened to the ties. With trucks askew of the track on an extra hard pull, a second engine to shove may avoid a possible tear in the rope, and save time. Nearly any derailed car can be quickly replaced without unloading and with little damage to the track. Where a piece of track is giving trouble, the ropes are carried on the locomotives, and only fifteen or twenty minutes are required as a rule for jobs that formerly took one-half hour to three hours.

Completing Diamond-Drill Hole

By Roy H. Poston

Written for *Engineering and Mining Journal*

It was found desirable to complete a surface diamond-drill prospect hole after it had broken into an underground drift that was easily accessible. The accompanying sketch shows how it was done. After "holing through," the drill rods were carefully let down to the bottom of the drift and the position was marked. They were then



DIAMOND-DRILL "HOLING THROUGH" A DRIFT

raised far enough to permit the placing of the sleeve pipe in the drift bottom, as shown, this pipe coming to within a few inches of the roof of the drift to insure the rods entering it when lowered. This pipe was well wedged in position at the bottom and held in place at the top by the 6 x 6-in. timber shown. No trouble was experienced in completing the hole.

Erasing With Bread Crumbs

By C. Nye

Written for *Engineering and Mining Journal*

To remove pencil marks from linen tracings without injuring ink lines, scatter over the tracing crumbs of the soft part of fresh rye bread, and with these crumbs under the palm of the hand, rub the tracing with a circular movement.

THE PETROLEUM INDUSTRY

The New Wamac Oil Pool, in Illinois

BY H. A. WHEELER
Written for *Engineering and Mining Journal*

THE GREAT ACTIVITY in the prolific Illinois oil fields closed with the discovery of the Carlyle pool (in Clinton County, western Illinois), in 1911, in which year the rich pool at Electra, Tex., attracted operators and speculators to the Mid-Continent fields from Illinois and all the older states. The continuous series of exceptionally rich pools that have been opened in Kansas, Oklahoma, Texas, Louisiana, and Arkansas since 1911 have monopolized the attention of the oil fraternity, and the older Eastern fields have been neglected, with the exception of the Kentucky outburst three years ago. The latter appealed to small operators, on account of its shallowness, despite its unfavorable record for erratic, short-lived producers.

The Allendale pool, in Wabash County, Ill., was discovered a few years after the Carlyle boom, but it proved to be much smaller than the older eastern Illinois pools, and attracted only local interest. Since then, no important oil discoveries have been made in Illinois, although a rich but limited gas field was discovered at Staunton, in Macoupin County, in western Illinois, in 1914, and the old Ava gas field, in Jackson County, southern Illinois, has finally developed into a producer of fair gas wells.

FAVORABLE GEOLOGICAL STRUCTURES STILL UNEXPLORED

Yet there are many attractive structures in western Illinois that have received limited or no attention, as the old Eastern oil operators are still largely ignoring geological aid, in striking contrast to the Mid-Continent operators, and to the enormous advantage of the latter, as the unprecedented, brilliant series of important discoveries that have been made in the Mid-Continent fields attests.

Based on encouraging geologic structure, the Petro Oil & Gas Co., of St. Louis, has been quietly wildcatting or prospecting in western Illinois, and after first bringing in small wells of dubious value, the company opened up a new pool in December at Wamac, in Marion County, in western Illinois, two miles south of Centralia, that promises to develop into a valuable producer. The drillers discovered a new sand—known as the "Petro sand"—at 800 ft., that is a new producing horizon in western Illinois. Four wells have thus far been brought in by the Petro company in six weeks, that came in at 100 to 300 bbl. from over 30 ft. of open, soft pay sand, with no water. Thus far little gas has occurred with the oil, so that the wells do not flow, and at present are shut in awaiting the erection of a pumping plant. The wells are small until shot with twenty or more quarts of nitroglycerin, after which the soft sand opens up and becomes a generous producer. As there is little caving, with no under-reaming and only one water sand to case off, little casing is required, and the wells can be drilled within a week at a moderate expense.

FIVE PRODUCING SANDS IN CENTRALIA DISTRICT

The great attractiveness of this field is the fact that this new Petro sand is No. 3 out of eight possible horizons. Five have been producing for the past twelve years in the Centralia district, namely:

The "Dykstra" sand (No. 1), at 600 ft., and the "Wilson" sand (No. 2), at 700 ft., that came in at from 5 to 25 bbl. The latter, or Wilson, sand was also found to be a light producer in the Petro pool, but for the present is being ignored for the much richer Petro or No. 3 sand at 800 ft.

The No. 4, or "Stein," sand occurs at about 1,400 ft., coming in with 25- to 100-bbl. wells in the near-by rich Sandoval pool and at 5 to 1,000 bbl. in the Carlyle pool, twelve miles distant.

The No. 5, or "Benoist," sand, at 1,500 to 1,650 ft., comes in with 50- to 500-bbl. wells and is a persistent sand throughout Illinois, being at the base of the Pottsville horizon.

All the above are "true sands," or sandstones, and occur in the lower Coal Measures, and to date no drilling has been attempted below the Benoist or No. 5 sand.

The following three deeper sands are productive elsewhere in Illinois and promise to become valuable producers in the Centralia district when deeper developments are attempted:

No. 6, or the "McCloskey," sand, which is an oölitic member of the St. Louis or Mississippi limestone. It occurs at about 1,700 ft., and produces 500- to 4,000-bbl. wells in Lawrence County, seventy-five miles east, and is the richest sand in Illinois.

The No. 7, or "Niagara," is a persistent, thick horizon of dolomitic limestone at about 2,200 ft. that is saturated with oil for over 100 ft. where it outcrops in western Illinois. On a good structure, such as occurs on the strong anticline at Centralia, this is likely to be a large producer.

The No. 8, or "Trenton," limestone should be found at about 2,500 ft. at Centralia and is the "Last of the Mohicans," or the lowest geologic horizon at which commercial quantities of oil have been found in this region. It is usually a pure, non-dolomatized, thick limestone, and for this reason was regarded as of no commercial importance by the Illinois Geological Survey, although I have always urged its development, as it shows more or less oil on its outcrop across the western Illinois border in Missouri. A few wells are producing from the Trenton in the Casey district in eastern Illinois, at a depth of about 2,600 ft., but though they come in at from 100 to 200 bbl., they quickly settle to small but persistent producers of a high paraffine oil. Last year

the Waterloo field in Monroe County, western Illinois, was opened in the Trenton horizon, where a heavy fault brings it within 400 ft. of the surface, and the wells come in at 20 to 200 bbl.

The No. 3, or Petro, sand oil is dark, has a good flash (high gasoline) and is 32 gravity Bé. It is of the usual Illinois grade, and sells today for $2.27 to $2.50 per bbl., and last year sold for $3.77 to $4 per bbl. As the Illinois pipe line is already at Centralia, and as there are three trunk roads (the Illinois Central, the Burlington, and the Southern railroads), the shipping facilities are exceptionally good, and adjacent coal mines (530 to 600 ft. deep to the No. 6 seam) furnish cheap fuel. This important discovery is so recent and is so slightly known that it has thus far created only a local boom, and close-in leases are selling at low prices. The old-time operators, who ignore geology, are shy of Centralia, on account of its past bad record; for though considerable drilling has been done east and north of town (never before to the south or in the Wamac district) during the last twelve years, it has been in a badly faulted, broken district where an occasional well would be surrounded by a ring of dry holes only one location distant. The old wells are on "pimples," or high spots in the sand, and unless the driller struck one of these limited pimples, operations resulted only in bringing in "dusters." The Wamac pool, on the contrary, shows a regular formation that is free from faults, and hence the outlook is bright for the development of a large, rich pool that should completely redeem Centralia's former reputation.

H. F. BAIN LOCATED CENTRALIA ANTICLINE IN 1903

It is interesting to note that when the present Illinois Geological Survey was organized, about 1903, under the directorship of Dr. H. F. Bain, the present Director of the Bureau of Mines, one of his earlier maps located the above Centralia anticline, to which he called attention as a possible oil field. This valuable information was ignored by over 95 per cent of the oil men, but when oil was struck in a new coal shaft at Junction City, two miles north of Centralia, in about 1909, drilling was started that later opened up the wells at the above-named mine at Sandoval and east of Centralia.

Last year the Petro company found some oil at Irvington, eight miles south of Centralia, and last month brought in the above-mentioned Petro pool two miles south of Centralia. Though these five pools vary greatly in value, they are all on the strong anticline mapped by Dr. Bain previous to any oil discoveries, and when as many tests have been made along this structure as along the La Salle anticline, in eastern Illinois, the field may duplicate the extremely profitable record of that exceptionally prolific series of large oil pools that have been developed by over 23,000 wells.

Increase in Petroleum Exports Since 1913

Petroleum exports from this country have increased greatly since 1913, according to the fuel division of the Department of Commerce in its surveying of last year's overseas trade.

Exports of crude oil in 1921 approximate an increase of more than 190,000,000 gal. over those of 1913, with a corresponding increase in value of more than $16,000,000. The quantity and value of refined products for 1913 was 1,941,996,000 gal., valued at $140,868,000, against about 2,411,000,000 gal., valued at approximately $359,700,000, in 1921.

The Oil Supply of the United States

A review of the producing, probable, and possible oil-bearing regions in the United States by a joint committee composed of members of the American Association of Petroleum Geologists and of the U. S. Geological Survey has resulted in an inventory estimate that 9,000,000,000 bbl. of oil recoverable by methods now in use remained in the ground in this country Jan. 1, 1922.

The committee responsible for the original preparation of the estimates and finally for the adjustment and revision of the results in joint conference comprised F. W. De Wolf, state geologist, Illinois; W. E. Wrather, Dallas, Tex.; Roswell H. Johnson, Pittsburgh, Pa.; Wallace A. Pratt, Houston, Tex.; Alexander W. McCoy, Bartlesville, Okla.; Carl H. Beal, San Francisco, Cal.; C. T. Lupton, Denver, Col.; Alexander Deussen, Houston, Tex.; K. C. Heald, Washington, D. C.; and G. C. Matson, Tulsa, Okla., representing the American Association of Petroleum Geologists; and, for the Federal Survey, David White, chief geologist, chairman; W. T. Thom, Jr., A. E. Fath, Kirtly F. Mather, R. C. Moore, state geologist, Kansas, and K. C. Heald. Mr. Heald represented both the Survey and the association. These men were assisted in subcommittees by a number of oil geologists, including oil-company geologists, directors of state geological surveys, and consulting geologists who were especially familiar with the regions considered.

The estimates for local areas, fields, or districts have been consolidated by states, groups of states, or broad regions in non-productive states, as follows:

ESTIMATED OIL RESERVES OF THE UNITED STATES, BY STATES OR REGIONS

	Millions of Barrels
New York	100
Pennsylvania	260
West Virginia	200
Ohio	190
Indiana and Michigan	70
Illinois	440
Kentucky, Tennessee, Northern Alabama, and Northeastern Mississippi	175
Missouri, Iowa, North Dakota, Wisconsin, and Minnesota	40
Kansas	425
Oklahoma	1,340
Northern Louisiana and Arkansas	525
Texas, except Gulf coast	670
Gulf coast, Texas and Louisiana	2,100
Colorado, New Mexico, and Arizona	50
Wyoming	525
Montana, Nebraska, and South Dakota	100
Utah, Nevada, Oregon, Washington, and Idaho	80
California	1,850
Eastern Gulf Coastal Plain and Atlantic Coast States.	10
Total	9,150

The New England states are regarded as too unpromising to deserve consideration. Most of the northern peninsula of Michigan and the State of Minnesota are placed in the same category.

Of the total estimated oil reserves of the United States, amounting in round numbers to 9,000,000,000 bbl., 5,000,000,000 bbl. may be classified as oil in sight and 4,000,000,000 bbl. as prospective and possible. Rather more than 4,000,000,000 bbl. should be assigned to the heavy-oil group. These oils will be recovered mainly in the Pacific Coast, Rocky Mountain, and Gulf states. The contents of the Lima-Indiana region, which yields oil of a distinctive type, are estimated at 40,000,000 bbl. In general the so-called paraffin oils of moderate and high grade, as contrasted with the heavier oils, amount in all to about 5,000,000,000 bbl. The estimated reserves of high-grade oils of the Appalachian states are about 725,000,000 bbl.

ECHOES FROM THE FRATERNITY

SOCIETIES, ADDRESSES, AND REPORTS

Western Editor Distributes Silver Medals to Walter Fitch, Jr., Co. Crew

The presentation of the silver medals, awarded to the shaft sinking crew of the Walter Fitch, Jr., Co. by *Engineering and Mining Journal*, took place at Eureka, Utah, on the evening of Jan. 19. Following a banquet, which was attended by the shaft men as well as local mine superintendents, foremen, and others, J. Fred Johnson, superintendent of the Chief Consolidated mine, introduced George J. Young, Western Editor of *Engineering and Mining Journal*. Mr. Young briefly discussed the relation of *Engineering and Mining Journal* to the mining industry. In presenting the medals, Mr. Young pointed out the great lesson to industry in the contest, dwelling upon the vital element of team work and co-operation, in that each man was particularly responsible for his part in the work. The medals presented are of silver, each being a replica of the gold medal and engraved with the name of the recipient. At the conclusion, Walter Fitch, Sr., president of the Chief Consolidated Mining Co., called attention to the fact that the contest was world-wide, and said that to the Tintic district fell the lot of winning by a remarkable margin. He thanked *Engineering and Mining Journal* for its recognition of the splendid work done in shaft sinking, on behalf of the recipients of the medals, the shaft crew foremen, shift bosses, and the Walter Fitch, Jr., Co. Mr. Fitch also extended his thanks to Mr. Young for his personal visit to the district and the distribution of the medals to the men. The medals for the few members of the shaft crew who were unable to be present were turned over to Superintendent Johnson for distribution.

Boston Section, A.I.M.E., Holds Seventy-Second Meeting

The seventy-second meeting of the Boston Section, A.I.M.E., was held at the Engineers Club, Boston, on Jan. 9, 1922, being preceded by the usual dinner. Allen H. Rogers, chairman of the committee on the affiliation of Boston technical and engineering societies, reported that the details of the plan were still being worked out, and will be submitted to members later.

F. W. Paine, G. W. Metcalfe, and Prof. E. E. Bugbee were appointed to serve as a committee to prepare nominations for officers for the coming year.

W. H. Bassett, technical superintendent and metallurgist of the American Brass Co., gave an interesting account of the formation of the Institute of Metals and its incorporation into the A.I.M.E. as the Institute of Metals Division. Robert J. Anderson, metallurgist of the U. S. Bureau of Mines, followed with an interesting illustrated talk on "Aluminum and Its Alloys." Mr. Anderson described the discovery and history of aluminum, its development and present application and the peculiar properties of its alloys. The last speaker of the evening was L. H. Pomeroy, of Cleveland, who described the application of the aluminum alloys to the automobile industry.

Columbia Section, A.I.M.E., Disapproves Proposed Revision of Mining Laws

Columbia Section, A.I.M.E., had charge of the noon meeting of the Associated Engineers on Dec. 28, at Spokane, Wash., with D. F. Henderson, president of Associated Engineers, in the chair. After the routine business of Associated Engineers, the meeting was turned over to Ivan De Lashmutt, chairman of Columbia Section, who called on several members to respond to the subject of "Revision of the Mining Laws." Speakers were Rush J. White, Dean Francis A. Thomson, Sidney Norman and others. None favored the proposed revision as a whole, but it was admitted that some changes in the present law are desirable.

Senator Miles Poindexter, the principal guest, stated that he was glad to have the opinions of local engineers and mining men and assured those present that nothing will be done in Congress without the advice and support of those most interested.

At the evening meeting, following a dinner, the election of officers for the coming year was held. Rush J. White was elected chairman; Frank M. Smith, vice-chairman, and L. K. Armstrong, secretary-treasurer. Mr. White addressed the meeting briefly, expressing his desire that more meetings of the section be held outside Spokane in the future, and he also spoke of the interest of mining engineers in the proposed revision of the national mining law.

The subject of the evening was the general topic, "The Geology of the Northwest, With Special Reference to Economic Possibilities." O. P. Jenkins, associate professor of economic geology at the State College of Washington, and Virgil Kirkham, of the geological faculty of the University of Idaho, were the speakers.

Mining Congress Formed in Durango

The Durango Mining Congress, of Durango, Mexico, has recently been organized for the purpose of collecting and distributing data on the mining industries in the State of Durango and in other ways be of assistance to those interested in mining in that district. Ernest Stein is secretary.

Reciprocal Agreement on Lead Between United States and Canada Sought

At a meeting of the Northwest Mining Association held on Jan. 19, the following resolution dealing with a phase of the lead-mining situation was unanimously carried:

Whereas, Senator Poindexter has initiated an effort to bring about a reciprocal agreement between Canada and the United States, providing that lead bullion derived from ores shipped across the international line, either way, may be returned free of duty to the country of origin; and

Whereas, Such agreement would not in any way interfere with the lead schedules provided for in the Fordney Tariff bill now before Congress and by which import duties of 2¼c. per pound upon lead bullion and 1¼c. per pound upon lead in ore of foreign origin are provided; and

Whereas, Adoption of such reciprocal agreement with Canada would provide alternative smelting outlets for ore from districts adjacent to the international line in British Columbia and Washington, thus promising more uninterrupted development and greater prosperity in both; Now, therefore, be it

Resolved, That the Northwest Mining Association, in regular weekly meeting assembled, this nineteenth day of January, 1922, heartily indorses and commends the action of Senator Poindexter and pledges its support in any manner that may bring about such reciprocal arrangement by legitimate means. It also calls upon other members of the Congressional delegation from this state [Washington] to support the efforts of Senator Poindexter, and suggests that the matter be immediately laid before public organizations in mining districts in this state and British Columbia, to the end that it may receive careful consideration on both sides of the international line and such recommendations as may seem proper to impress the desires of both peoples upon their respective governments; and be it further

Resolved, That the officers of this organization be and hereby are directed to send copies of this resolution to the Honorable Mackenzie King, Premier of Canada; Senator Poindexter; the chairman of the Finance Committee, United States Senate; to the Chairman of the Ways and Means Committee, House of Representatives; to members of the Congressional delegations from Northwestern states and civic bodies in the Kootenay district of British Columbia and northern part of the State of Washington, with the request that favorable action be taken.

Colorado Petroleum Geologists Organize

The Rocky Mountain Association of Petroleum Geologists was organized in Denver on Jan. 26. Max Ball was chosen president; J. M. Douglas, vice-president, and C. B. Osborn, secretary-treasurer. Semi-monthly meetings will be held in Denver, the next meeting being scheduled for Feb. 9. The program includes the presentation and discussion of papers pertaining to the geology of the Rocky Mountain region.

Committee Chairmen for N. W. Mining Convention Selected

Chairmen for all committees for the Northwest Mining Convention to be held at Spokane, Wash., on Feb. 14, have been appointed by the trustees of the organization. The various chairmen appointed were as follows: Program, Frank A. Ross; entertainment, Fred Howe; finance, G. B. Dennis; publicity, Major R. A. Laird; reception, C. A. Gram; information, J. T. Omo; mineral exhibits, R. A. Moore, and transportation, C. H. Goodsell.

MEN YOU SHOULD KNOW ABOUT

G. C. Bateman, of Cobalt, Ont., was in New York last week.

Glenn L. Allen has returned to Warren, Ariz., from Guadalupe, Mexico.

G. M. Colvocoresses, of Humboldt, Ariz., was recently in San Francisco.

R. L. Chase, of Denver, is in Indianapolis on business pertaining to mining interests.

N. M. Bullock, of Rockdale, Tex., has been appointed a member of the State Mining Board of Texas by **Governor Neff.**

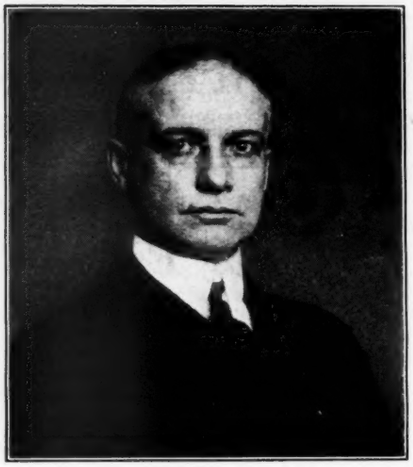
Rush T. Sill, of the firm of Sill & Sill, has returned from examination work in Randsburg and the Slate Range, in California.

A. B. Needham, of Harrisburg, Ill., has accepted a position on the engineering staff of the Butte & Superior Mining Co., Butte, Mont.

A. T. Thomson, assistant to the president of the Phelps Dodge Corporation, with headquarters in New York, was a recent visitor at Clifton, Ariz.

A. G. Mackenzie, of Salt Lake City, was in New York last week, after having attended the ore freight rate hearings before the Interstate Commerce Commission in Washington.

J. S. Negru, managing editor of *Chemical and Metallurgical Engineering*, will sail for Europe on Feb. 11 for a six months' trip through Germany, France, Belgium, and other European countries. The purpose of the trip is to study industrial and economic conditions and observe the latest advances in science, engineering, and technology.



ROBERT I. REES

Colonel Robert I. Rees has been named by the President as assistant director of the U. S. Veterans' Bureau, in charge of its rehabilitation division. Colonel Rees is a graduate of the Michigan College of Mines. He was a distinguished graduate of the Army School of the line in 1913 and of the Army Staff College in 1914. He served as a corporal of Company B of the Engineers' Battalion during the Spanish-American War. He was commissioned as second lieutenant in 1899 and served through the successive ranks of lieutenant, captain, major, and colonel, and on July 22, 1918, was appointed temporary brigadier general. Colonel Rees has been awarded the D. S. M. and is an officer of the French Legion of Honor. He is a member of the National Research Council and and active member of the George Washington Post No. 1, American Legion of the District of Columbia. As assistant director in charge of rehabilitation, Colonel Rees will have direct supervision of the rehabilitation of more than 104,000 disabled veterans who are in training, both in private and governmental institutions. He will have direct charge of all vocational schools and training establishments, and will assume the responsibility for the rehabilitation of the men who were disabled in the World War.

George A. Stahl, of Denver and Cripple Creek, has been elected president of the Colorado Metal Mining Association for the coming year. Other officers named by the board were: **Jesse F. McDonald**, of Leadville, first vice-president; **R. M. Anderson**, of Breckenridge, second vice-president; **Bulkeley Wells**, of Denver, third vice-president, and **M. B. Tomblin**, of Denver, secretary and treasurer.

George E. Collins, of Denver, has been re-elected governor of the Colorado chapter of the American Mining Congress. Other officers re-elected by that body, which met jointly with Colorado Metal Mining Association, were: **J. F. Welborn**, first vice-president; **Charles A. Chase**, second vice-president, and **George A. Stahl**, third vice-president. **A. M. Collins** was re-elected treasurer, and **M. B. Tomblin**, secretary.

F. N. Bendelari, manager of the Underwriters' Land Co., was elected governor of the Tri-State branch of the American Mining Congress at the meeting of the organization held at Picher, Okla., on Jan. 13. He succeeds **Edgar Z. Wallover, Jr.**, of the Golden Rod M. & S. Co. Directors for the organization elected included: **M. F. Owen**, manager of the Black Eagle Mining Co.; **C. F. Dike**, manager of the Montreal Mining Co.; **John W. Newton**, manager of the Commerce Mining & Royalty Co.; **W. T. Landrum**, manager of the Cortez Mining Co.; **P. W. George**, manager of the Federal S. & R. Co.; and **C. A. Rice**, manager of the Laclede L. & Z. Co., The organization is made up exclusively of mine operators.

Mining and metallurgical engineers visiting New York City last week included: **W. F. Ferrier**, Toronto, Ont.; **Charles R. Meissner**, Pittsburgh, Pa.; **Thomas H. Clagett**, Bluefield, W. Va.; **Rudolph Ericson**, Iron River, Mich.; **Edwin A. McKanna**, Tampico, Mexico; **O. N. Scott**, Toronto, Ont.; **W. W. Weigal**, Rolla, Mo.; **W. S. Hartman**, Dayton, Ohio; **C. B. Browning**, Britannia Beach, B. C.; **H. J. Morgan**, Cleveland, Ohio; and **L. F. Tefft**, Wallace, Idaho.

SOCIETY MEETINGS ANNOUNCED

The Iron and Steel Institute will hold its annual meeting on May 4 and 5, at the House of the Institution of Civil Engineers, London.

American Ceramic Society will hold a convention in St. Louis, Mo., Feb. 27 to March 3 inclusive. There are seven divisions in the society; hence, seven conventions will be held simultaneously. These are as follows: Ceramic Art, White Art, Refractories, Glass, Enamel, Heavy Clay Products, and Terra Cotta.

OBITUARY

Ralph Muir, formerly a prominent zinc mine owner of Joplin, Mo., died in San Diego, Cal., on Jan. 17. He was born in Canada seventy-nine years ago, and had made his home in San Diego for the last seven years.

George R. Comings, an assayer at the U. S. Assay Office in New York City, died on Jan. 17 at his home, 51 Quincy St., Brooklyn, after being in the Government service forty-eight years. He was born in Cos Cob, Conn., on June 2, 1860, received his education in New York City schools and obtained a degree in chemistry from Cooper Union. Mr. Comings entered the Assay Office at the age of thirteen and worked under Dr. Torrey, who was the first assayer in the history of the office and who was succeeded by his son, Herbert G. Torrey, Mr. Comings succeeding the latter on Nov. 1, 1910.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Leading Events

The Utah Consolidated Mining Co., of Bingham Canyon, Utah, has been granted a new trial of the apex case in which the decision was awarded the Utah Apex company.

Iron-ore operators of northern Minnesota have opened their fight on the so-called occupational tax law passed by the last Legislature. The State Tax Commission has been enjoined from examining the companies' books until the constitutionality of the law has been judicially decided.

The mine taxation situation in California is to be surveyed by a committee of the American Mining Congress. Taxes paid by Arizona operators are set forth on p. 222 of this issue.

Reduction of ore freight rates is a matter now being considered by the Interstate Commerce Commission. Favorable action on basic commodities is likely to be obtained, it is thought.

Transfer of ownership of various mining properties is reported. The East Butte Copper Co. has acquired holdings in Colorado; the McCracken silver mine, in Arizona, has been sold; the United Eastern directors have bought the control of a Mexican silver property. Coniagas, at Cobalt, has taken an option on the Ruby.

Decision in Hollinger's Suit Delayed

Judgment Reserved for Three Weeks in Case Against Northern Canada Power Co.

Judgment has been reserved for three weeks in the case of the Hollinger Consolidated Gold Mines against the Northern Canada Power Co. The action brought was for damages of over $2,000,000 for failure to supply the full requirements of the Hollinger company according to the terms of the power contract, which gave the Hollinger first call on power. The power company claimed that the contract was with the original Hollinger, before the amalgamation with the Miller Middleton and the Acme.

Hollinger at present is treating 4,000 tons a day and using 8,000 hp. The power required during 1922 will probably increase to 10,000 hp. During the course of the trial it was brought out that the ultimate aim of the directors is from 7,000 to 8,000 tons-daily capacity.

The company has declared the regular four-weekly dividend of 1 per cent, payable Jan. 28. Hollinger directors have an option on the Murray properties, near Elbow Lake, in northern Manitoba, and are taking in large amounts of supplies. An option on claims in West Shining Tree, held by the same interests, has been dropped.

Colorado Smelting Situation Being Studied

Edgar Newhouse, chairman of the board of directors of the American Smelting & Refining Co., was in Denver during the annual meeting of the Colorado Metal Mining Association and was in conference with a committee of that organization regarding smelting conditions in Colorado. Important changes are expected as a result of the conference.

Rand Strike Continues

By Cable From Reuters to "Engineering and Mining Journal"

Johannesburg, Jan. 27.—The conference between mine owners and representatives of the unions was broken up without achieving any result.

Wallaroo & Moonta To Suspend

By Cable From Reuters to "Engineering and Mining Journal"

Adelaide, Jan. 23—Announcement is made that the Wallaroo & Moonta Mining & Smelting Co., of South Australia, is suspending operations owing to the continued depression of the copper market.

Utah Consolidated Gets New Trial

The Utah Consolidated Mining Co., of Bingham Canyon, Utah, has been granted a new trial in its litigation with the Utah Apex Mining Co. over ore claimed by both companies, and adjudged to belong to the Utah Apex by the United States District Court of Salt Lake City, which ordered the Utah Consolidated to pay damages of over $1,000,000. In granting the motion of the Utah Consolidated for a rehearing of the case before the Circuit Court of Appeals, Judge Johnson, of the Utah court, fixed the bond of the Utah Consolidated at $1,300,000 to act as a supersedeas bond and as a bond for costs and damages on appeal.

The Utah Consolidated opened and mined a large tonnage of ore beneath the holdings of the Utah Apex, which it claimed according to apex rights as making in the Highland Boy limestone, the ore-bearing formation of the Consolidated. The Utah Apex claimed the ore on the ground that it had its occurrence in connection with the Utah Apex fissure system; and this claim was upheld by the Utah court after much interesting expert testimony had been offered by both sides.

Occupational Tax Fight Now On in Minnesota

Iron-Mining Companies Get Order Restraining Tax Commission From Examining Books

Active steps have been taken by the iron-mining companies of northern Minnesota to test the constitutionality of the new occupational tax on iron-ore operation which became a law April 11, 1921. The Oliver Iron Mining Co., a subsidiary of the United States Steel Corporation, and thirty independents secured a temporary order in the United States District Court at Duluth on Jan. 24, enjoining officials of the state from proceeding with the collection of this tax. In the petition of the plaintiffs the constitutionality of the law is questioned in a number of its vital phases.

Two days later, at a preliminary hearing in Duluth, Judge Page Morris granted an order restraining the state from examining the companies' books holding that the companies would suffer an irreparable loss if the state were allowed to examine the books and the law were later held unconstitutional. A hearing on the interlocutory injunction will be held in Federal court at St. Paul about March 1, before three Federal judges, who are to be designated later.

The law provides that all iron-ore operators shall pay to the state an occupational tax of 6 per cent of the valuation of all ores mined, in addition to all other taxes. The state tax commission has recently sent to the mining companies blank forms calling for data from which the first taxes under the new law were to be computed, and it was for that reason that proceedings were instituted at this time.

The petitioners assert that the tax is a property tax. The state laws already place a general ad valorem tax on all ores mined or unmined. It is claimed that the new law places a

double tax upon ore mined in any one year; whereas during the year that the ore is in the ground it is subject to but one tax. The plaintiffs assert that they are therefore denied equal protection of the laws provided by the Federal Constitution and that the state Constitution is violated wherein it states that taxes must be uniform upon the same class of subjects.

It is further asserted that the tax is on one article of interstate commerce (as 98 per cent of the ore is shipped outside the State of Minnesota) and is for that reason unconstitutional, as Congress alone has the right to regulate commerce.

If the tax is an occupational tax, it is claimed, it violates the provision allowing equal protection, by singling out one industry. The state law does not permit taxes on occupations, it is said. If it is an income tax, they say, then it is also unconstitutional, for the state statutes do not sanction a tax on incomes.

Colorado Operators Will Cut Wages Again

No Reduction at Cripple Creek—Notice Filed With Industrial Commission

Notice has been filed with the Colorado Industrial Commission by the principal metal-mine operators of Telluride, Leadville, Aspen, and other districts in the state, that, effective March 1, there will be a wage reduction of 50c. per shift for all surface and underground employees. It is understood that operators at Cripple Creek will make no reduction at this time, as the scale for this camp is already 25c. below that paid in other districts. The reduction will make a $3.50 minimum applying to muckers, trammers, and surface men. Under the new scale machine men will receive $4 to $4.25.

Testimony in Star Injunction Case Continued

Presentation of evidence by the plaintiffs in the injunction proceedings brought by Eugene R. Day and Sarah E. Smith, to restrain the Hecla Mining Co., of Wallace, Idaho, from joining with the Bunker Hill & Sullivan Mining & Concentrating Co. in acquiring a joint interest in the Star Mining Co., at Mullan, Idaho, continued last week at Spokane. Part of the time was taken up by arguments of counsel for both sides as to the admissibility of evidence tending to show the Star property as worthless to the Hecla company on the lines of the proposed deal. The court decided that such evidence should be largely eliminated. There was further argument as to whether the Hecla directors' action in acquiring a half interest in the Sullivan Mining Co. was *ultra vires*. No decision had been given as to this up to the time of writing. The Sullivan Mining Co. was organized by the Hecla and the Bunker Hill & Sullivan companies for the joint operation of the Star mine.

Conditions Improving in Arizona Copper Camps

Little Activity Yet, but Preparations Are Under Way—Old Dominion To Resume

Optimism prevails in the copper camps of Arizona, though warnings are given that unskilled labor will not be needed from outside for some time. President James S. Douglas of the United Verde Extension has announced that his company will resume production at the Clemenceau smelter about March 1, though with a relatively small output and employing about 500 men at mine and works. He hopes to secure added economy by shipping bullion via Los Angeles and Panama. United Verde within a few days will start a steam shovel at work toward the old glory hole, above the mine, but there is no intimation as to when mine and smelter operation will be resumed. About 150 men are to be employed. In addition, contracts are to be given at once for the erection of a million-dollar crushing plant that is to be completed by August.

Old Dominion, at Globe, is to start a furnace some time in March, according to the general manager, W. G. McBride. He says that much work is to be done underground, in repairs and in preparing stopes for ore production. Then the ore bins will be filled before the first furnace is blown in. Mr. McBride also says that this district has no surplus of skilled men, though rather too many of the unskilled are already on hand. Old Dominion was producing at the rate of 2,000,000 lb. of copper a month at the time of closing last spring, but is not expected to get back to this for several months.

At Douglas, several hundred men are employed on repairs to the Copper Queen smelter, with sixty days' work ahead. A new roof is being put on the smelter building, the reverberatory and roaster stack is being repaired, and the blast furnaces are being put in condition for operation. Few are being employed save skilled men, and these from the old force. General Manager Hodgson is moving headquarters of operations for the Arizona Copper mines from Clifton to Morenci. From that district comes word only of improvements to be made, which are to cost millions of dollars and to take many months for completion. Recently it was announced that operations are to be resumed at the Iron Cap and Superior & Boston properties at Globe.

Oregon Opposes Mining Law Revision Bill

The provisions of the Arentz mine law revision bill have been made the object of a protest to Congress by the Oregon Legislature. Particular objection is made to placing a limit on the time in which mining claims may be patented. The Legislature holds that the proposed revision would retard the development of mining resources.

East Butte Acquires Property At Silver Plume, Col.

Takes Over Seven-Thirty, Dives-Pelican and Diamond Tunnel — Will Build 400-Ton Flotation Plant

Negotiations which have been pending for some time were recently consummated whereby the East Butte Copper Co., of Montana, takes over the Dives-Pelican, Seven-Thirty, and Diamond Tunnel properties, which include a group of over sixty claims, all within a mile of Silver Plume, Col. Workmen are dismantling the old Neshotah mill, which will be replaced with a 400-ton flotation plant. The properties contain more than twenty miles of underground workings, and a large part of the tonnage for the mill will come from dump rock and stope fillings. A large force will at once be employed in clearing out and retimbering the old drifts and opening up undeveloped territory.

It is said that the purchase price is a little under $500,000, the first payment, one of 5 per cent, being less than $25,000. It is also reported that the company can drop the project at any time, so that the arrangement is practically as if it had taken the properties under option. Enough ore is said to be already in sight to pay the purchase price.

Santa Fe Announces Cut on Small Shipments

The Santa Fe railway company has announced a freight rate cut on less-than-carload ore shipments to 130 per cent of the carload rate.

Would Exempt Diamond-Drill Explorations From Taxes

Bill To Be Presented in Michigan Legislature—Present Method Checks Development

A bill will be drawn up for presentation to the Michigan Legislature to exempt diamond-drill explorations from taxation for a period of five to ten years. There is some talk of a special session, and it is held that the proposed measure will be presented then. It will be introduced by Representative P. H. O'Brien, of Iron River. He has written Governor Groesbeck in part as follows concerning his bill:

"There was a time in my own district when six or seven diamond-drill corporations were exploring for iron ore. Now there are none, because as soon as the drill records a deposit of ore, the property is placed upon the assessment roll. The result has been that mining companies have discontinued diamond-drill exploring, and the country has remained undeveloped. My suggestion is to exempt all diamond-drill explorations for a period of five to ten years, and then, if properties are not developed, to place them on the tax roll. Thus diamond-drill explorations would be encouraged throughout the entire upper peninsula, with a resulting benefit to the entire country."

Arizona Commission To Prosecute Delinquent Corporations

After deliberation on the subject for many months, the Arizona Corporation Commission is about to start action against Arizona corporations that have failed to observe the requirements of state laws with respect to the filing of annual reports, with accompanying fees. About 1,000 corporations are delinquent, involving an apparent loss to the state of about $2,000,000.

Gold Rush to Elbow Lake, Man., Under Way

A rush to the Elbow Lake district in northern Manitoba, where gold was discovered last May, is in progress. The original discovery was made by the Murray brothers, who sold an option on two claims to the Hollinger Consolidated Gold Mines, Ltd., of Porcupine, Ont. This company examined the claims during the summer and began work in October and now has an engineer and twenty-five men employed. It is also cutting a sleigh road from Mile 56 on the Hudson Bay railroad northwest to the claims. It is said that two trenches were cut across the orebody, one 75 ft. long and the other 60 ft. long, both showing values all the way. The gold is coarse. Claims are being staked.

Coarse gold was first found in this region at Copper Lake, twelve miles from Elbow Lake, by J. P. Gordon in 1919. The Gordon claims have since been diamond drilled.

NEWS FROM WASHINGTON

By PAUL WOOTON
Special Correspondent

Ore Freight Rate Reductions Thought Likely

Change Would Benefit Basic Commodities — Producers' Representatives Heard by Interstate Commerce Commission

That railroad rates on iron ore should be reduced materially has been the contention of many witnesses appearing before the Interstate Commerce Commission during the consideration of the case which involves a review of the rate structure of the entire country. P. S. Sprague appeared for the Lake Superior Iron Ore Association. His argument dealt chiefly with the rates from the mines to the upper Lake ports, but the need for the reduction also applies between the Alabama mines and Southern furnaces. Closely linked with this demand has been the insistence that the rates on pig iron must be reduced before any material reduction in the cost of steel can be effected. The present rate on pig iron was declared by some witnesses to be throttling the whole foundry industry.

Judging from questions asked and the general attitude of the commission, it is probable that rates will be reduced on basic commodities, particularly on low-class freight. It is evident, however, that the commission is going to be absolutely sure that the transportation machine is not impaired by these reductions. The members of the commission are calling in each instance for facts and figures, and apparently are not convinced that a general reduction in rates will mean increased revenue through an increased volume of business. They are determined to know just how the revenue of the carriers will be affected by each specific reduction demanded. Witnesses frequently are asked if they prefer low rates to an assurance of service.

Practically all witnesses agree that coal should be favored in rate reductions. The general opinion seems to be that coal rates at least should be relieved of the 1920 increases. In that connection, it is pointed out that iron-ore rates have not been increased to the same relative extent as have the rates on coal. No one predicts that reductions will be made prior to April 1.

A reduction in the rate on metallic ores was urged by A. G. Mackenzie, secretary of the Utah chapter of the American Mining Congress. He also asked that there be a reduction in the rate on bullion from the West to New York. High freight rates, he said, are causing great waste, in that only the higher-grade ores can be shipped.

Committee Favors Duty on Tin As Protective Measure

Domestic Smelting and Refining an Infant Industry—Financial Juggling Abroad a Factor Considered

Though no final decision has been reached by the Finance Committee, it is understood that it is favorably inclined to a duty on tin in bars, blocks, pigs, or in granulated form. The committee apparently is convinced that a duty is necessary to the maintenance of the domestic tin smelting and refining industry. Another important feature is the fact that a duty on tin would be a large revenue producer.

Reliable information in the hands of the Finance Committee indicates that the several plants in this country which have attempted the smelting and refining of tin have operated at a loss. As the industry dates only from 1916, it falls clearly within the infant industry class. It has been established to the apparent satisfaction of the committee that costs abroad are lower. A specific duty of 4c. has been asked by the smelting interests to enable them to compete on equal terms in the refining of Bolivian ores. An argument to which weight is attached is that such a duty would enable American refiners to purchase Chinese ores, thereby making for the development of a new source of supply.

Another factor evidently influencing the Finance Committee is the financial juggling of tin which takes place in the London and Straits Settlements markets. The existence of an American industry established on a stable basis would tend to stabilize prices.

Ford's Offer for Muscle Shoals Ready for Congress

Will Benefit Public Greatly, Say Proponents—Means Subsidizing Private Enterprise, According to Those Opposed

Henry Ford's offer for the Muscle Shoals water-power project and the Government nitrate plants near by has been duly signed by Mr. Ford and is now before the President. The offer is to be formally transmitted to Congress, along with the comment of the Secretary of War, in the near future.

A clash of major proportions is certain to mark the legislative course of this proposition. It is being fought on the one hand by those who claim that private enterprise will be receiving the equivalent of a subsidy from the public treasury. The proponents of the Ford proposal argue that it presents the alternatives of accepting this offer or of writing off an investment of $105,000,000. In addition, they contend, the acceptance of the offer assures great public benefit in that it will utilize a resource now going to waste and will provide for the fixation of atmospheric nitrogen—a necessary step for the national defence. In addition, there is the important matter of introducing a powerful competitor to the existing fertilizer interests and the assurance of the development of the extensive bauxite deposits in the states of the central and eastern South.

Patent Office Relief Bill Passes House

Despite the opposition of such influential members as majority leader Mondell and Chairman Madden of the Appropriations Committee, the House has passed without amendment the Patent Office relief bill by the overwhelming vote of 305 to 44. The Senate Committee on Patents expects to consider the bill immediately, and it is known that a majority of the committee favors the reporting of the bill to the Senate on the earliest possible date.

NEWS BY MINING DISTRICTS

London Letter

Labor's Attitude Causing Comment—Kalgurli Mine's Record Good—Consolidated Mine Selection May Pass Dividend

BY W. A. DOMAN

London, Jan. 10.—In mining circles the attitude of labor has formed the chief topic of discussion for the last week, and, in fact, is the main topic at the moment. Whether one turns to South Africa, Australia, or West Africa, this matter seems uppermost. In Australia, of course, the demands of the workers' unions, with the helplessness of the authorities, have reacted with boomerang effect upon the Broken Hill Proprietary Co., so far as its steel works at Newcastle are concerned, and the Barrier Range mines are also affected. Most prominent, however, now is the strike of white miners in the Transvaal, both on the coal and gold mines. Wage reductions are the root cause, the men apparently refusing to face the economic facts, and demanding virtually the same pay as when the gold premium was high.

The initial mistake was made in allowing the miners a share in the premium when it was first obtainable, or, at any rate, without making it clear that a fall in the premium would mean the wiping out of the advances conceded. According to the latest news, matters have now come to such a pass that the Chamber of Mines is even willing for the natives to be repatriated and the mines to be closed down rather than to be continually at the mercy of the unions, which threaten to dislocate the industry unless their demands are granted. The selling price of the gold before the premium was obtainable was 85s. per oz. For December last, the output is calculated to fetch 93s. 9d, or only 8s. 9d. above normal. To the bulk of the mines, this meager advance does not provide sufficient margin to allow profitable working to be carried on.

The old Kalgurli mine has done remarkably well by its shareholders. It has earned a profit right up to the very end. In November, the mine and the plant were disposed of to the Oroya Links for £20,000, and on the capital of £120,000 it is expected that the shareholders will receive almost £1 a share. The company entered the dividend list in 1901, and has not once been a defaulter. The total distributed to date, apart from what may come in the liquidation, exceeds £1,705,000.

A rumor is current, and I give it with all reserve, that the Consolidated Mines Selection will not pay a dividend for the past twelve months. Whether this story is put out for speculative purposes, or whether it is a *ballon d'essai*, is not clear, but when the circumstances are considered, it may contain a shred of possibility. The company is interested in the Southwest Africa diamond industry, and no income is at present being derived, or seems likely to be derived for a considerable time, from that source, owing to the depression in the diamond trade. The Brakpan and Springs mines have made reduced distributions, and it is not unlikely that the company has been called upon—always, of course, with its associates, for the Consolidated Mines Selection directors are too astute to shoulder such heavy burdens alone—to give substantial assistance to some of its subsidiaries, especially the West Springs. Financial undertakings have their ups and downs, and Walter McDermott has at recent annual meetings of shareholders of the Consolidated Mines Selection plainly hinted that dividends could not be expected to continue on such a generous scale.

Johannesburg Letter

Strike at Crown Mines Causes Drop in November Gold Output—Diamond Situation Reviewed

BY JOHN WATSON

Johannesburg, Dec. 20—A fire on the 8th level of the Ferreira Deep on Dec. 8 resulted in the fatal gassing of one man. While efforts were being made to extinguish the fire, a fall of rock occurred at the 7th level station, catching five timbermen and ultimately causing their death.

The Transvaal gold output for November was declared on Dec. 10 as 704,236 fine ounces. Compared with October this shows a decrease of 3,589 oz. The chief factor causing the decreased output has been the strike at the Crown Mines, whose decrease of 4,098 fine ounces is the largest on the list. The East Rand Proprietary Mines shows a drop of 3,027 oz. The largest producer for the month was Government Gold Mining Areas (State mines) with a total of 62,726 fine ounces, this being an increase of 2,709 over the October figure.

At the annual meeting of the De Beers company, held at Kimberley on Dec. 9, the chairman, Sir David Harris, reviewed the operations of the year ended June 30 last, which had been a critical and trying one for the diamond industry. Large quantities of Russian brilliants had been thrown on the world's market by the Soviet government and others, and these had been sold for cash to American and other countries, at about half the ruling rates for South African diamonds. During the last two years the De Beers company had paid over £2,000,000 in taxes. The company has decided to cease all operations except town-lighting, trams and pumping, which will affect 650 men.

AUSTRALIA

Queensland

Hampden-Cloncurry Mining on Limited Scale—New Guinea Company To Ship Ore to Australian Smelters

From Our Special Correspondent

Brisbane, Dec. 14—Two of the three large copper companies in the Cloncurry district, the Hampden-Cloncurry and the Mount Cuthbert, have just issued statements showing their respective positions. Neither did any smelting in 1921, because it was impossible for them to do so profitably with wages and other costs as high and the price of copper as low as it has been during the period.

The directors of the Hampden company say that substantial reductions in wages, railway freights, and in the cost of general supplies are necessary before any resumption is economically possible. This company has done well in the past. There is still a surplus of liquid assets over liabilities amounting to £88,700. During the time the smelters have been idle, 1,000 tons of ore has been drawn from the Duchess mine, and the management suggests that mining on a limited scale, 100 tons of ore per day, shall be resumed at two of the company's mines, and the ore dumped on the surface, to assist the position when smelting is resumed. This work has already been started, and forty men are engaged on it.

The manager of the Hampden-Cloncurry Mines, Ltd., is also the manager for the New Guinea Copper Mines, Ltd., and he has recently, after a visit to the properties of the latter company, brought news to Queensland regarding its operations and the bearing of these operations on copper mining in this state. The Debuna and Laloki mines, held by the Papuan company, are now ready to produce ore, and satisfactory arrangements have been made for the working of the mines by native labor. About £250,000 has been spent in developing the mines and in building a railway, jetties and other necessary equipment. The proved ore reserves of the two properties are given by Mr. Huntley as 235,000 tons of ore averaging roughly 4½ per cent of copper and 2½ dwt. of gold per ton. It has been decided not to erect smelters in New Guinea, but to ship the ore to the mainland after it has been treated locally in such a way as to prevent the liability to firing in transit. As it is highly basic, it is believed that a ready market will be found for it by companies that have siliceous ores awaiting a suitable fluxing material. In addition, the 40 per cent sulphur content has a considerable commercial value. The company itself owns the Mount Chalmers mine, in Queensland, and it should be able to utilize that property to advantage by the use of ore from Laloki.

CANADA

British Columbia

Suit Over Engineer Mine To Be Appealed—Operations at Premier, Surf Inlet and Granby

Stewart — Regular shipments of sacked high-grade ore are expected from the Silverado group within a few weeks. It will be transported to the lower camp by tram and thence rawhided to tidewater. The Premier mine is the only substantial shipper from the district at present. Many miners and prospectors are wintering at Stewart and Hyder. George Clothier, the resident mining engineer, is advocating more trails, and it is assured that Government assistance, as far as finances will permit, will be extended where it is recommended.

The eleven-and-a-half-mile aerial tramway of the Premier mine was put in operation on Dec. 20. Two large compressors, coupled to two Diesel units, have been installed and are in operation, and a concrete foundation has been built at the foot of Cascade Creek ready for building the housing for the machinery of the main power house, which, it is expected, will be finished early this year.

The average number employed in 1921 was 382, the total tonnage mined 15,129 tons, the total length of tunnel and drifting 4,027 ft., and the total diamond drilling done, 6,821 ft. About 50 ft. from the entrance of No. 2 tunnel a 5 x 6-ft. shaft has been sunk to a depth of 420 ft., connecting Nos. 3 and 4 workings. It is supplied with steel cage, guides and the required safety devices, and is used for hoisting men and supplies.

Anyox — Referring to the Hidden Creek mine and the smelter operations of the Granby Consolidated Mining & Smelting & Power Co., the inspector of mines states that low copper prices compelled two cuts in wages during the year, that the number of the employed had to be cut materially, and that the loss by fire of main crusher No. 2 at the mine necessitated rebuilding and the installation of a new crusher. This was completed in October. The structure is of concrete and is fireproof. The average number of men employed during 1921 was 212, as against 385 for 1920, and the output in wet tonnage from the Hidden Creek mine for the year was 914,000 tons, as against 802,667 tons for the previous year, an increase of 112,333 tons.

Surf Inlet—As to the Belmont Surf Inlet Gold Mines, Ltd., the inspector says that the Pugsley mine, which adjoins the Belmont and is owned by the company, may be considered an established producer. Ore bins have been built for handling its output, and an aerial tramway has been constructed from these to the bunkers at the head of the Surf mine. The tram is a two-bucket high-speed reversible type, capacity per bucket being 1,500 lb., and the span between buckets 2,300 ft. It is operated by a 25-hp. motor. The elevation between terminals is 390 ft. and the capacity per eight hours 100 tons.

Sidney Inlet—Operations will be resumed soon on the Tidewater Copper Co.'s property at Sidney Inlet, Vancouver Island. Important ore reserves are said to have been blocked out.

Vancouver—An appeal has been entered by the Engineer Mining Co. against the recent judgment handed down by the British Columbia courts, which leaves the Engineer mine, at Atlin, in the hands of the heirs of the late Allan I. Smith, to whom the mine was left by the will of the late Captain Alexander. It is said that the action will be carried to the Privy Council before the litigants will be content to consider the issue settled.

Trail—Ore shipments received at the Consolidated smelter Jan. 15 to Jan. 21 totaled 8,631 tons, of which 8,256 tons came from company mines. Other shippers were: Arlington, Slocan City, 5; Bell, Beaverdell, 39; Knobhill, Republic, Wash., 29; L. T., Slocan City, 6; Ottawa, Slocan City, 32; Paradise, Lake Windermere, 35; Rosebery Surprise, New Denver, 175; and Rambler Cariboo, Rambler, 54.

Ontario

Coniagas Takes Option on Ruby—Dome Announces Capital Repayment

Cobalt—The Coniagas has taken an option on the Ruby property, adjoining the Green Meehan mine, in the northeast end of the camp. This isolated section has produced several hundred thousand ounces, and it is believed that the Huronian formation, in which practically all the ore in Cobalt is found, persists under a considerable portion of the Ruby ground, and that it offers good possibilities for prospecting. A diamond drill will first be used to determine the geology.

Kirkland—The discovery of rich gold ore on the claims of the Lightning River Gold Mines has resulted in considerable staking in that area. At present prospectors must travel forty miles from Kirkland on snowshoes.

At the annual meeting of the Teck Hughes no announcements were made regarding recent developments, as had been anticipated. It is understood that a strike has been found at 600 ft. Rich ore has been opened up for a length of 150 ft. on the 900 level of the Kirkland Gold.

During 1921 over 900 claims were recorded in the Larder Lake mining division, which is 200 more than for 1920, the best previous year.

Porcupine—The long-anticipated capital repayment by the Dome has finally been announced by the directors, who have decided to pay $1 a share on April 20 to shareholders of record March 31. Some changes in the charter will be necessary and the consent of the Lieutenant Governor in Council will have to be obtained.

MEXICO

Jalisco

Amparo and Cinco Minas Reduction Plants Only Ones in Operation—Mezquital del Oro Mine Leased

In common with other industries and general trade, mining in Jalisco is almost stagnant, and there is little worthy of note to be recorded. General world conditions are affecting Mexico as well as most other countries, and it is evident that no great activity can be looked for until the return to normal of all business. But little capital can be interested in silver mining, which is the principal branch of the industry followed in Jalisco. Political and labor conditions are not causing anxiety, and there is nothing to prevent active development and exploitation of the mineral wealth of the state as far as these are concerned. Travel, even in the remotest districts, seems absolutely safe, and scouts are to be seen everywhere.

Only two reduction plants are now operating in the state, those of the Amparo Mining Co., at Etzatlan, and of the Cinco Minas Co., at Hostotipaquillo. Both plants are running at capacity.

The Mexican company owning the Piedra Bola mine, not far from Ahualulco, has decided to erect a mill and cyanide plant for the treatment of its lower-grade ores, and machinery and equipment are now being purchased. The company has been shipping large quantities of high-grade ore to the smelter for some time, and it has accumulated ample cash resources. It is reliably reported that offers for the purchase of the mine were made by the Amparo Mining Co., and the El Oro Mining & Railway Co., both of which were refused.

The United States Smelting & Refining Co. has given up its option on the Mazata mine.

The El Oro Mining & Railway Co. is keeping the pumps at work in the Casados mine, but it is greatly feared that this option will also be dropped.

The Pinabete mine, which has not been touched during the revolutionary troubles, is being cleaned out and retimbered. This mine has a great reputation, and it is hoped that work will be continued uninterruptedly.

The Mezquital del Oro mine has been taken under lease and bond by E. J. Hunter & Co., of San Antonio, Tex., and work has been resumed in a crosscut started some years ago to explore parallel veins outcropping not far from the original Mezquital vein, famous as having given a number of bonanzas. The Mezquital mine is one of the few gold mines of Mexico, there being practically no silver in its ores. The mine is also somewhat singular in that as far down as mining operations have been carried on, about a thousand feet, the ore is still oxidized.

R. J. Cottna, of Worcester, Mass., has formed the San Geronimo Co. to take over and operate mines in the Mascota district, and it is said that machinery and supplies for a mill and cyanide plant are already at Vera Cruz.

ARIZONA

Mining Companies Pay About Half of Total State and County Taxes, Excluding Collateral Levies

BY JAMES H. MCCLINTOCK

Phoenix — Next to transportation costs, the greatest subject of criticism among officials of Arizona mining companies is taxation. Of each $100 assessed for state, county, and city purposes, the mines are now paying $50.73, compared with $12 for railroads, $3.97 for livestock, and $1.83 for motor vehicles. According to the state tax commission, during the current fiscal year state, county, and municipal revenues in Arizona will amount to $17,431,558, and it is apparent that mines are depended upon for paying a material part of the public costs, though in only a few instances are they charged with city taxes.

The tax commission believes its system of mine assessment, based upon physical valuation and bullion product, is a good one. There has been comparison of the assessment from 1916 to 1920, inclusive, with the values of the mining stock as shown on the New York stock board, in semi-annual readings. The stock values of the Phelps Dodge, United Verde, or Arizona Copper properties cannot be estimated, for these stocks are not dealt in on the exchange; but the average stock value of the other large mines for the period specified was $269,945,761. The average Arizona tax assessment on the indicated properties per annum was $261,479,912. The assessments on these same mines for the current year aggregate $268,544,147.

The estimate that about one-half of the taxes of Arizona, state and county, is paid by the mining corporations does not include taxation on such collateral industries as mining railroads, mercantile establishments, banks, and even towns that are dependent upon the mining industry for their existence. Although the tax valuations of the several mines have been a matter of record, the actual cash paid in taxes has not had as much publicity. It has, to a material degree, been dependent upon the varying tax rates of the counties. Individual mines do much toward support of the several counties. For instance, Arizona Copper pays 58.06 per cent of the income of Greenlee County, Ray Consolidated 57.27 in Pinal County, Inspiration 47.54 in Gila County, New Cornelia 34.7 in Pima County, and United Verde and United Verde Extension respectively 35.75 and 30.7 in Yavapai County.

The actual taxes paid by Arizona mines from which reports have been received are to be listed as follows: Phelps Dodge, Morenci, $217,662; Bisbee-Douglas, $919,973; total, $1,137,635; Inspiration, at Miami, $851,061; United Verde, Jerome-Clarkdale, $664,334; Calumet & Arizona, Warren, $619,123; Ray Consolidated, at Ray (Pina County), $556,680; at Hayden (Gila County), $61,130; total, $617,810; United Verde Extension, Jerome-Clemenceau, $552,495; Arizona Copper, Clifton, $482,242; Miami Copper, Miami, $440,455; New Cornelia, Ajo, $439,497; Old Diminion, Globe, $182,642; United Eastern, Oatman, $114,915; International Smelting, Miami, $95,569; Magma, Superior, $70,992; Arizona Commercial, Globe, $33,712; American Smelting & Refining, Hayden, $32,295; Iron Cap, Globe, $30,780; Ray Hercules, Ray, $21,673; and Tom Reed, Oatman, $18,392.

The Amalgamated Copper Mines Co., in its effort to block construction of a flood check dam on Cave Creek, north of Phoenix, has secured change of venue, alleging local bias, due to self-interest. The plaintiffs have given bond and will start work at once.

Kingman — The McCracken silver mine, in southern Mohave County, has been taken over from F. A. Garbutt by L. D. Adams and Joseph C. Buchen, said to represent Eastern interests. It is said that the property is to be equipped with a 150-ton mill. Sufficient water for the plant is available.

Oatman—Contracts have been signed by the Tom Reed management for milling fifty tons of ore a day for the United American and fifty tons for the Telluride property. Charges have been fixed at cost plus $2 a ton. American ore will go through the Tom Reed 400 level to the Aztec shaft, and thence be trammed to the mill. Telluride ore will go to the mill by auto truck. The ores are about the same as have been milled in the past, and there is assurance of high extraction. The mill is handling about 125 tons a day, mainly from the east side line, near the Big Jim ground recently awarded the company in the litigation with United Eastern.

Henry Zulch, engineer for the Tom Reed Gold Mines Co., has completed a model and maps of the underground workings and veins of the ground in dispute with the United Eastern.

Announcement has been made that the directors of the United Eastern have taken over a controlling interest in El Tigre, an old silver property, 175 acres in extent, in the State of Nayarit, Mexico, 100 miles south of Mazatlan and ten miles from the Southern Pacific of Mexico. Title has just been secured through favorable action of the Mexican Federal authorities, and cash is understood to have been paid. The main vein, 15 ft. wide, has been gouged to about 50 ft. in depth, but is to be opened by modern methods.

COLORADO

Cornucopia Company's Mill Making Initial Run

Blackhawk—The new fifty-ton mill of the Cornucopia Mining & Milling Co. is making its initial run. The property is in the Perigo district, eight miles north of Blackhawk, and has been under development for two years. It is said that large bodies of milling ore have been opened up from the tunnel workings. Amalgamation, concentration, and flotation will be employed to save the gold, silver, and copper.

CALIFORNIA

Mine Taxation Situation To Be Surveyed — Pattinson Mine Building Twenty-Stamp Mill—Many Small Properties Active

San Francisco.—Preparatory to surveying the mine taxation situation the American Mining Congress has appointed the following committee for California: C. E. Jarvis, of the California State Board of Control; Albert Burch, E. E. Paxton, of the Engels Copper Mining Co., Newton Cleveland, of the Yuba Consolidated Gold Fields Co., and Robert I. Kerr, secretary of the California Metal and Mineral Producers' Association. It is stated that the present system of mine taxation in use in California is too stringent in comparison with that applied to other industries. A survey of conditions is to be made and a more equitable system of taxation is to be recommended.

The Kennedy mine, at Jackson, is now operating forty stamps continuously, and has cleaned out the debris resulting from the flooding of the mine two years ago. Ore is being mined on the 4,050 level. The Argonaut is operating at maximum capacity. Although certain clews to the robbery of the amalgam which took place at the Argonaut some time ago have been unearthed, the thieves are still at large.

The wire-rope tramway of the Mountain Copper Co., at Keswick, has been completed and is expected to be put in operation soon. The tax suits started by this company and by the Mammoth have been decided in favor of the companies. The hull of the Gardella dredge near Lewiston, Trinity County, has been completed, and the machinery will soon be installed. The Shasta Zinc & Copper Co. will, it is expected, resume operation this spring.

Many small or two- and three-man gold properties are being opened up in Plumas, Sierra, and Nevada counties.

In Inyo County there is much activity in the silver-lead prospects and mines. The Birch Creek Mining Co. is operating a silver mine near Big Pine. The Black Eagle, at Independence; the Bunker Hill mine, at Big Pine, operated by the Base Metals Co.; the Casa Diablo, near Bishop, the Old Custer, at Darwin, and the Jumbo, at Big Pine, all small properties, are now operating. The Tecopa Consolidated is employing about seventy men and is shipping silver ore. It is the largest operation in the county. The Cerro Gordo has only a few men at work.

In Tuolumne County, the Pattinson mine, near Tuttletown, is building a twenty-stamp mill. The Nevada Wonder Mining Co. has taken an option on the Chilino mine, near the Pattinson, close to Tuttletown.

In El Dorado County, the El Dorado Lime & Minerals Co. is opening up a limestone deposit near White Rock, and has proved, according to a local report, an extensive deposit. The Grit mine is operating ten stamps. The Poverty Point mine is to be reopened, and work is to be resumed at the Jones property.

NEVADA

Old Wine Property Sold—Ore From Camp of Platinum Shows Gold Only

By Our Special Correspondent

Virginia City—The Old Wine Mining Co.'s property, south of Gold Hill, has been purchased jointly by the Comstock El Dorado Mining & Milling Co., of Reno, and the Spearhead Gold Mining Co., Reorganized, of Goldfield. The property has been opened to a depth of 700 ft., but some of the workings are now inaccessible. Production is estimated as $1,000,000. Gold values predominate. The Spearhead equipment in Goldfield will be moved to Gold Hill and work begun cleaning out the main shaft and preparing for resumption of development.

Hazen—A shipment of 2,625 lb. of ore from Platinum, ten miles north of Winnemucca, assayed 9 oz. gold per ton. The ore was tested for platinum, with negative results. There was considerable discussion several weeks ago over the reported finding of platinum here.

Mina—The mill of the Simon Silver-Lead Mines Co. is operating successfully. Output is about three carloads per week of silver-lead concentrates, and about the same of zinc concentrates. The silver-lead concentrates assay 35 oz. silver, 50 per cent lead, and 8 per cent zinc, or 80 per cent recovery of the lead and zinc. The zinc concentrates assay 42 per cent zinc, 6 per cent lead, and 5 oz. silver, or a recovery of 62 per cent of the zinc contents. Most of the silver and lead in the zinc concentrates will be saved at the company smelter at Harbor City, Cal., which assures a total recovery of about 90 per cent of the silver and lead contents in the ore.

Tonopah—The Tonopah Belmont continues to produce over 500 tons of ore per day and to accomplish the usual amount of development work. There is no change in production at the West End, Tonopah Mining, or Tonopah Extension. At the MacNamara and Montana mines, leasers are at work and doing well.

Argentite—At the Sanger mine, the original discovery in this district, eleven men are at work. Hoisting and compressor machinery are now being installed, and work will soon be resumed in the north and south drifts on the 100 level. Both of these faces are said to be in milling ore. On the Ecklund property the only work is shaft sinking, and the management intends to continue sinking to 200 ft. depth before doing any lateral work from the shaft.

Divide—The report covering the Tonopah Divide Mining Co.'s operations for 1921 is optimistic. With a net profit for 1921 of $101,559, cash in banks on Dec. 31, $126,945, and official statements regarding increasing ore reserves, with discussion of plans for the construction of a mill, it would appear that the company has several years of profitable operations to look forward to, with good prospects of important developments on the lower levels.

Ely—Mining operations, excluding work at the Ruth mine of the Nevada Consolidated Copper Co., are almost at a standstill, but every indication points to early resumption of activity by both the Nevada Consolidated and Consolidated Coppermines, the forces of these companies being gradually increased in the last two months. Work at adjoining camps has been held up by heavy snow and severe weather. An important strike of siliceous silver ore is reported at the Exchequer mine, at Cherry Creek.

Pioche—Increased tonnage from the Black Metals mine, made possible by the opening of a new stope of richer silver fluxing ore, featured the shipments from the Pioche district for the week ended Jan. 27. A smaller shipment was made by the Bristol Silver Mines, owing to cold weather. Black Metals, Inc., shipped 265 tons and the Bristol 90 tons.

E. D. Smiley plans to build a combined concentrator and cyanide plant for treating lead-silver oxidized ores. He has obtained a lease from the Amalgamated Pioche Mines & Smelters Corporation on the old Yuba mill site.

OREGON

Co-operative Claimholders' Association Incorporated Under New Law

Bourne—The tonnage handled at the E. & E. mill has been increased to 140 daily, the result of recent improvements to the plant. Further changes are planned which will make it possible to handle 200 tons daily.

Grant's Pass—The first mining company to incorporate under Oregon's special co-operative law has been chartered by the state commissioner. It will be known as the Co-operative Claimholders' Association, and the head office is at Grant's Pass. The property of the company embraces 1,500 acres of placer ground in the Waldo mining district of Josephine County.

Homestead—Work is being done in preparation for the sinking of a 300-ft. shaft on the property of Copper Syndicate Co., near Homestead.

IDAHO

Armstead Mill Nearing Completion

Sandpoint—The high-voltage transmission line to the Armstead mine, at Talache, is completed. The power, which will be supplied by the Mountain States Power Co., will be used for operating the new mill.

Hailey—The Compensation group of sixteen claims, near the Minnie Moore mine, has been bonded by L. A. Dithmer, to Kenyon and Reynolds, of Burley. The property has been inactive for years. A small crew is working.

Wallace—The Star Mining Co., following the settlement of its litigation with the Federal Mining & Smelting Co. on account of trespass on the Star ground through the Morning mine, at Mullan, Idaho, has declared a dividend of $250,000.

MONTANA

Anaconda Preparing To Resume at Berkeley and Pennsylvania Mines —B. & S. Working Three Shifts

BY A. B. KEITH

Butte—Butte & Superior's copper-ore development on the 2,600 level of the Black Rock mine has been the principal feature of the week locally. In grade the ore is running practically the same as on the upper level, but there is evidence that it will be found in greater tonnage. Bunches of glance and bornite occur in larger masses, and engineers express the opinion that it is possible that marked enrichment may be found at any time. The company is now employing three shifts, totaling more than 600 men, and the number will gradually be increased to 1,000. Work is being rushed at the Black Rock concentrator, and it is hoped to have this plant working in the course of a few weeks.

The Anaconda Copper Mining Co. is preparing to resume operations at the Berkeley and the Pennsylvania copper mines in addition to the Mountain View, where track-laying is nearly completed, preparatory to starting. With these three mines in operation, the company will be working seven of its larger properties.

Repair work is under way at the Boston & Montana reduction works at Great Falls, particularly at the refining plant. Officials believe that operations in this department can be resumed by Feb. 15. A report is in circulation in Anaconda circles that plans have been made for doubling the capacity of the Greene-Cananea plant, but this cannot be verified, although no denial is forthcoming. The Anaconda is an owner of Greene-Cananea stock, and in addition leading officials of the former are credited with possessing good blocks of this stock. With Anaconda's metal output inadequate to supply the normal copper and zinc requirements of American Brass, it is presumed that Inspiration Copper, which the Anaconda controls, and Greene-Cananea will be called in to supply any deficiency.

North Butte is reported to be considering deep-development work in consequence of the Butte & Superior's disclosure of copper ore on the latter's 2,600 level, and it would not be surprising were the company to consider crosscutting the northwest veins in the Rainbow group of claims, which property is controlled by interests that are affiliated.

The Davis-Daly and East Butte companies are expected to get together soon in the matter of lower smelting rates for the former, which will permit a resumption of operations at the Colorado mine, which formerly furnished the Pittsmont smelter of the East Butte with its largest customs tonnage. East Butte has resumed operations at its Elkhorn gold properties. It has also recently acquired property at Silver Plume, Col. (see p. 218).

UTAH

Question of Freight Reductions to the Fore—New Strike at Columbus-Rexall Holding Out

By Our Special Correspondent

Salt Lake City—The campaign to reduce freight rates in the intermountain region is being watched with much interest by Utah mining men. Such a reduction is of great importance to the welfare of the state and to its most important industry, the mining and smelting industry, which, according to figures compiled by A. G. Mackenzie, secretary of the Utah chapter of the American Mining Congress, employs 30 per cent of all the men in the state covered by workmen's compensation insurance. It is estimated that of the total cost of production freight charges represents about 22 per cent. Wages and other costs are being lowered to the level of 1913, but unless freight rates also come down there is little chance of betterment. In summing up the situation, Mr. Mackenzie estimates that in 1913 there were 213 operators and that in the present year there are only 131. Those mines which are able to continue operations are the producers of ores with a high silver content, and these are shipping only their higher-grade ores, which is, of course, a wasteful method of operation.

Metal quotations, with the exception of those of silver, fixed at $1 an ounce by the Pittman Act, have reached the pre-war level, and, if it were not for the Pittman Act, all of the metal mines of the state would have to close down. Exclusive of the Utah Copper Co., shipments (mainly silver-lead ores) in 1913 amounted to 2,683,174 tons, and in 1921 the tonnage of these ores dropped to 751,800. In 1917 the ore shipped from Utah had a silver content of 4.6 oz. per ton and 63.3 lb. lead. This content steadily increased, until in 1921 the silver content per ton was 16.38 oz. and the lead content, 119.4 lb. The average value of the ore was $11.71 per ton in 1917 and in 1921 it was $25.84. These figures speak for themselves. It is estimated by H. W. Prickett, of the Utah traffic bureau, that with freight rates on ore as low as the pre-war rates, the ore tonnage of the Western carriers would in a few months increase to 65 per cent over the shipments of 1921.

Park City—Shipments for the week ended Jan. 20 amounted to 2,024 tons, as compared with 1,983 tons the week preceding. Shippers were: Judge allied companies, 912 tons; Silver King Coalition, 823; Ontario, 289.

Alta—At the Emma mine, development work is being done on the Montezuma fissure, recently cut in a drift from the Bay City tunnel level. The fissure was lost through faulting. Raising is being done on a stringer of ore encountered in the work. A forty-ton shipment recently ran 39 oz. silver and 5 per cent lead.

Officials of the Columbus-Rexall report the new strike is holding out and is of importance.

MICHIGAN

The Copper Country

Calumet & Helca Preparing Rapidly for Resumption — 8,650,000 lb. Refined Copper in January

BY M. W. YOUNGS

Houghton.—At the Calumet & Hecla mines, repairs are being speeded preparatory to resuming production. The most extensive work under way is in the conglomerate department of the Calumet & Hecla. It is unlikely that all of these shafts will be ready for mining operations by April 1, for the vein in the lower levels has caved badly and a longer period will be required for the removal of broken ground and reconditioning of the shafts. Several of the shafts, however, will doubtless be ready by that date. Two shifts of timbermen are at work in several of them.

The Allouez shafts are in good condition, and will require little repair, although no mining has been done in them since July, 1920. Allouez is well opened in its lower levels, and the stopes in both Nos. 1 and 2 shafts yielded a better grade of rock in 1920 than had been milled in some years. The yield averaged closed to 19 lb. to the ton, about 3 lb. better than in 1919, and the percentage of discard was only half that of 1919. Normally, Allouez's output is close to 10,000,000 lb annually.

Three shifts of timbermen are at work in Ahmeek's No. 2 shaft, replacing the concrete skipway with timber. This is the biggest job on the Ahmeek program, and it is believed that it can be completed before April 1. Ahmeek openings are generally in good condition.

A small number of men have been taken on at Isle Royale, where all underground openings are ready for actual mining. The most important repair work here will be in No. 5 shaft, where the concrete skipway will be replaced with timber for 1,000 ft. or more. This work can easily be completed before April 1. The Isle Royale mill is in good condition and can be started whenever it is needed. Isle Royale should be one of the first properties to get back to normal.

Construction of the power house and hoisting plant at the Seneca company's Gratiot No. 2 shaft will be started early in the spring. Work in the shaft will be temporarily suspended while concrete is poured for the collar. All openings in Seneca continue in good ground. The property now has nearly 8,000 ft. of drifts.

Six furnaces are now in service at the Calumet & Hecla smelter, two of which are working on special orders and four smelting cupola blocks.

The refined metal output of smelters in the Michigan copper district in January was estimated to be 8,650,000 lb. This is approximately 40 per cent of normal. The month closed with ten furnaces in blast. Of these Calumet & Hecla had six, Quincy one, and Michigan (Copper Range, Hohawk and Wolverine) three.

MINNESOTA

Cuyuna Range

Court Orders Assessment Against Cuyuna-Minneapolis Iron Co. Stockholders

Brainerd—Receivers for the Cuyuna-Minneapolis Iron Co. have secured favorable action upon an application for a court assessment against the stockholders of the company. On Jan. 21 Judge McClenahan, in the district court here, held that because the articles of incorporation of the company embraced other powers than merely mining operation, double liability could be held against the stockholders. He accordingly ordered an assessment of $1 on each of the million shares.

The Cuyuna-Minneapolis Iron Co. was the operator of the Ida Mae mine, on the north Cuyuna Range, a manganiferous iron-ore property active during the war. The operators spent $300,000 on development, and have been paying $45,000 per year royalties, although the property has been idle for two years. The stock of the company is in the hands of about 500 stockholders in eleven states, the majority being held in Pennsylvania. It is stated that one Pennsylvania banker owns 365,000 shares, holds $275,000 of a "gold bond" issue of the company, and $50,000 in promissory notes.

JOPLIN-MIAMI DISTRICT

Missouri-Kansas-Oklahoma

Flannery Mine May Start Again—Republic Property Changes Hands—Oronogo Circle Resumes

BY P. R. COLDREN

Joplin—Walter F. Friday, of Pittsburgh, Pa., has been in this district to look over the Flannery mine, at Sarcoxie, Mo. If the price of zinc ore should improve, this mine will be started again. It is a sheet ground property, and was a steady producer for several years. Its principal owner is said to be State Senator William Flynn, of Pittsburgh.

The Cosden-Aiken interests, which own the Admiralty Zinc mines, have taken over the old Republic property, in the south part of Picher, Okla., and are operating it under the name of the Helen Mining Co.

After being closed for over a year, the Oronogo Circle mine, at Oronogo, owned and operated by the Connecticut Zinc Co., started on Jan. 15. The Circle plant is the largest in the district, not excepting the Eagle-Picher Lead Co.'s Netta concentrator at Picher. It is managed by A. J. Burnham, of Joplin, and preparations for reopening have been under way for several months. Underground pillars have been blasted away, so that the open-air mining operations can be pursued, and several electric drags and underground crushers have been installed. Since the plant shut down, many "gougers" have been working on the property, and have taken out considerable lead ore. Eleven acres of land have been cleared of the surface dirt.

THE MARKET REPORT

Daily Prices of Metals

Jan.	Copper, N. Y., net refinery* Electrolytic	Tin 99 Per Cent	Tin Straits	Lead N. Y.	Lead St. L.	Zinc St. L.
26	13.375	30.25	31.00	4.70	4.375	4.55@4.60
27	13.375	30.25	31.25	4.70	4.375	4.55
28	13.375	30.25	31.25	4.70	4.375	4.525
30	13.25@13.375	30.75	31.50	4.70	4.40	4.50
31	13.25@13.375	31.375	32.00	4.70	4.40	4.50
Feb. 1	13.25	31.00	32.00	4.70	4.375@4.40	4.45@4.50

*These prices correspond to the following quotations for copper delivered: Jan. 26, 27, 28, 13.625c.; Jan. 30, 31, 13.50@13.625c.; Feb. 1, 13.50c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York, cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin.

London

Jan.	Copper Standard Spot	Copper Standard 3M	Copper Electrolytic	Tin Spot	Tin 3M	Lead Spot	Lead 3M	Zinc Spot	Zinc 3M
26	64 7/8	65 3/8	71 1/4	155 3/4	157 1/2	23 1/8	23	25 1/2	26
27	64 1/2	65 3/8	71	157	158 3/4	23 1/8	23	25 5/8	26 1/8
28	...	...	...	.....	.....	...	...	...	...
30	64 1/2	65 1/4	71	157 1/2	159 1/4	23 1/8	22 7/8	25 3/4	26 1/8
31	64	64 3/4	71	159 1/2	161 1/4	22 3/4	22 1/2	25	25 1/2
Feb.1	63 1/4	64 1/8	70	158 1/2	160 1/4	22	21 3/4	24 3/4	25 1/4

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

Jan.	Sterling Exchange "Checks"	Silver New York Domestic Origin	Silver New York Foreign Origin	Silver London	Jan.	Sterling Exchange "Checks"	Silver New York Domestic Origin	Silver New York Foreign Origin	Silver London
26	422 1/4	99 5/8	65 1/8	35	30	425 1/4	99 5/8	66 1/8	35 3/8
27	423 1/4	99 5/8	65 1/8	34 7/8	31	427	99 5/8	66 1/8	35 1/4
28	424 1/4	99 5/8	65 1/2	35 1/8	Feb.1	428	99 5/8	66 3/8	35 1/8

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

Average Metal Prices for January

Copper:	
New York Electrolytic	13.465
London Standard	65.226
London Electrolytic	72.321
Lead:	
New York	4.700
St. Louis	4.388
London	23.667
Silver:	
New York, foreign	65.450
New York, domestic	99.625
London	35.035
Sterling Exchange	421.750
Zinc:	
St. Louis	4.691
London	26.321
Tin:	
99 per cent	31.480
Straits	32.100
London	163.065
Antimony	4.463
Quicksilver	49.960
Platinum	97.260

Metal Markets

New York, Feb. 1, 1922

Extreme sluggishness continues to characterize the local metal markets. The price of copper asked by the smaller interests has succumbed further to the lack of demand, and the same is true of zinc. Lead is in fair demand at unchanged prices, and tin is slightly higher, owing to higher sterling exchange rates. Industrial conditions generally are not improving as fast as was expected.

Copper

Two or three fair-sized orders have been placed during the last week, but the purchasers in each transaction were careful to get the best price possible. The deliveries were generally for the second quarter. Most of the business of which we have reports was done on a 13.50c. delivered basis, but it was of small total volume. The larger producers continue out of the market, and as most of them are in a satisfactory financial position, they are likely to be content to wait several weeks longer if necessary before forcing any copper on the market. Should a buying movement begin, the price of copper would probably react to the 14c. level quickly, as no great tonnages are available at much under this price. However, it may be another month before any buying of importance develops, and in this interval it would not be surprising to see the price drop even slightly under current quotations.

Export business has been confined almost entirely to interests outside of the Copper Export Association, whose prices have been such as to net about 13.375c., f.o.b. refinery. The Export Association's price remains at about 14c. delivered, which is too high to attract possible buyers.

Lead

The official contract price of the American Smelting & Refining Co. continues at 4.70c. This is about the level at which prompt lead can be obtained in New York from other interests also. Demand has not been large, but has kept up well with that of recent weeks. The several lots of lead in the St. Louis district which were being offered up to Saturday at 4.375c. were apparently taken off the market over the week-end, and on Monday and Tuesday most of the business was placed at 4.40c. Today however, a slight weakness seems again to have developed, and there are rumors that 4.35c. might be done on good-sized orders for early delivery. The statistical position of lead continues excellent, and producers are not worrying over the decline in London. That has been caused by arrivals from Spain which were more than sufficient to take care of the demand. Spanish production would probably be curtailed though if the price dropped much further.

Zinc

There was no prolonged pause in the decline in zinc during the week. Although several large producers attempted to accommodate only their

regular customers, other producers sold fairly large tonnages on the decline. A fair inquiry has been reported for forward delivery, as far ahead as April and May. For that position a premium is being generally asked of about 10 points, but some producers are hesitant about quoting on future zinc. The high-grade market is unchanged at 6c. with freight allowed.

Tin

The price of tin has advanced somewhat, owing both to the advance in London and the stronger quotation of sterling exchange. Buying has been of fair volume by solder manufacturers, but tin platers seem well supplied. The scarcity of spot tin continues, but this should be relieved early in March, when three or four large cargoes are due to arrive.

Tin for April delivery was quoted at the following discounts from spot: Jan. 26th, 0.125c.; 27th, 0.25c.; 28th, 0.25c.; 30th, 0.375c.; 31st, 0.75c.; Feb. 1st, 0.50c.

Arrivals of tin, in long tons: Jan. 25, London, 225; total for January, 4,275; Warehouse stocks, 696; landing, 635; total visible supply, 5,606.

Gold

Gold in London: Jan. 26th, 97s. 5d.; 27th, 97s. 4d.; 30th, 97s.; 31st, 96s. 6d.; Feb. 1st, 96s. 3d.

Foreign Exchange

During the last week sterling reached the highest figures since August, 1919. The rise is attributed to short covering. On Tuesday, Jan. 31, francs were 8.28c.; lire, 4.57c.; and marks, 0.4975c. New York funds in Montreal, $5\frac{3}{16}$ per cent premium.

Silver

Buying in the London market by the Indian bazaars for this week's shipment to India has advanced the price for ready silver, and the market has also been steadied by the lack of sales from China, Shanghai being closed on account of the New Year holidays. There have been orders in the New York market at somewhat below the parity of the London spot price, but the chief strength locally has come from the sharp advance in sterling exchange. The immediate future of the market will depend upon the position of China when business is resumed after the holidays.

Mexican Dollars—Jan. 26th, 49⅝; 27th, 49⅝; 28th, 49¾; 30th, 50¼; 31st, 50¼; Feb. 1st, 50½.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—20c. per lb. for 99 per cent grade; 19c. for 98@99 per cent; 18c. for 94@98 per cent. Outside market nominal at 17@18c. for 98@99 per cent virgin grades.

Antimony — Chinese and Japanese brands, 4.45c.; market dull. W.C.C. brand, 5¼@5¾c. per lb. Cookson's "C" grade, spot, 9c. Chinese needle antimony, lump, nominal at 4c. per lb. Standard powdered needle antimony (200 mesh), nominal at 5.25c. per lb.

White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, wholesale lots, 6½@7c.

Arsenic—7½c. per lb.

Bismuth—$1.90@$2 per lb.

Cadmium—$1@$1.10 per lb., in 1,000-lb. lots. Smaller quantities, $1.10@$1.25 per lb.

Cobalt — Metal, $3@$3.25 per lb., black oxide, $2 per lb. in bbls.

Iridium—Nominal, $170@$190 per oz.

[1]**Molybdenum Metal — In rod or wire form, 99.9 per cent pure, $32@$40 per lb., according to gage.**

Nickel—Standard market, ingot and shot, 41c.; electrolytic, 44c. Small tonnages, spot, nominal at 32c.

Monel Metal—Shot, 35c.; blocks, 35c., and ingots, 38c. per lb., f.o.b. Bayonne.

Osmium—$70 per troy oz. Nominal. $70, Los Angeles, Cal.

Palladium—Nominal, $60 per oz.

Platinum—$100@$105 per oz.

Quicksilver—$46@$48 per 75-lb. flask. San Francisco wires $48.70.

[1]**Rhodium**—$150 per troy oz.

[1]**Selenium — Black powdered, amorphous, 99.5 per cent pure, $2@$2.25 per lb.**

[1]**Thallium Metal—Ingot, 99 per cent pure, $20 per lb.**

[1]**Tungsten Metal—Wire, $35@$60 per kilogram, according to purity and gage.**

Metallic Ores

Chrome Ore—Ore analyzing 40@45 per cent Cr_2O_3, crude, $18@$20 per net ton; ground, $25; analyzing 45@50 per cent Cr_2O_3, $19@$21; ground, $25; f.o.b. Atlantic ports. Quotations are nominal.

Iron Ore—Lake Superior ores, per ton, Lower Lake ports: Old Range bessemer, 55 per cent iron, $6.45; Mesabi bessemer, 55 per cent iron, $6.20; Old Range non-bessemer, 51½ per cent iron, $5.70; Mesabi non-bessemer, 51½ per cent iron, $5.55.

Magnetite Ore—F.o.b. Port Henry, N. Y.: Old bed 21 furnace, $4.85; old bed concentrates, 63 per cent, $5.75; Harmony, cobbed, 63 per cent, $5.75; new bed low phosphorus, 65 per cent, $8.50.

Manganese Ore — 22@24c. per unit, seaport; chemical ore, $45@$60 per gross ton, lump. Nominal.

Molybdenum Ore—85 per cent MoS_2, 48@50c. per lb. of contained sulphide, New York. Quotation purely nominal.

Tantalum Ore—Guaranteed minimum 60 per cent tantalic acid, 50c. per lb. in ton lots.

[1]**Titanium Ores**—Ilmenite, 52 per cent TiO_2, 1½@2c. per lb. for ore. Rutile, 95 per cent TiO_2, 12c. per lb. for ore, with concessions on large lots or contracts.

Tungsten Ore—Scheelite, 60 per cent WO_3 and over, per unit of WO_3, $3, f.o.b. Atlantic ports. Chinese, as low as $2; Nominal.

[1]Furnished by Foote Mineral Co., Philadelphia, Pa.

Uranium Ore (Carnotite)—Ore containing 1½ per cent U_3O_8 and 5 per cent V_2O_5 sells for $1.50 per lb. of U_3O_8 and 75c. per lb. of V_2O_5; ore containing 2 per cent U_3O_8 and 5 per cent V_2O_5 sells for $2.25 and 75c. per lb., respectively; higher U_3O_8 and V_2O_5 content commands proportionately higher prices.

Vanadium Ore—$1 per lb. of V_2O_5 (guaranteed minimum of 18 per cent V_2O_5), New York. Nominal.

Zircon—Zirconium silicate, f.o.b. Pablo, Fla., 4½@13c. per lb.

[1]**Zirkite—According to conditions, $70 @$90 per ton, carload lots. Pure white oxide, 99 per cent, is quoted at $1.15 per lb. in ton lots.**

Zinc and Lead Ore Markets

Joplin, Mo., Jan. 28—Zinc blende, per ton, high, $30.55; basis 60 per cent zinc, premium, $26; Prime Western, $25; fines and slimes, $24@$22. Average settling price, all grades of blende, $27.89.

Lead, high, $63.50; basis 80 per cent lead, $60; average settling price, all grades of lead, $61.04 per ton.

Shipments for the week: Blende, 8,560; lead, 1,498 tons. Value, all ores the week, $330,200. Shipments for the month: Blende, 28,466, lead, 7,388 tons. Value, all ores the month, $1,260,210.

Shipments for the month have exceeded output, drawing from the reserve stocks several hundred tons of ore. Purchases each week continued strong throughout the month, though the price level was lowered.

Platteville, Wis, Jan. 28—Blende, basis 60 per cent zinc, $28 per ton. Lead ore, basis 80 per cent lead, $60 per ton. Shipments for the week: Blende, 202; lead ore, 223 tons. Shipments for the year: Blende, 1,403; lead ore, 273 tons. Shipped during the week to separating plants, 364 tons blende.

Non-Metallic Minerals

Asbestos — Crude No. 1, $1,000@$1,200; No. 2, $500@$750; spinning fibers, $200@$300; magnesia and compressed sheet fibers, $110@$200; shingle stock, $80@$125; paper stock, $45@$55; cement stock, $12.50@$17.50; floats, $7@$10, all per short ton, f.o.b. Thetford, Broughton and Black Lake mines, Quebec, Canada.

Barytes—Crude, $6@$7 per ton, f.o.b. mines. Ground white, $23, f.o.b. mills. Off-color grades, $17@$21, f.o.b. Southern mills. Foreign barytes, crude, f.o.b. New York, $7 per ton.

Bauxite — French bauxite, $8@$10 per metric ton, c.i.f. Atlantic ports. American bauxite, crushed and dried, $8@$10 per gross ton, f.o.b. shipping points; pulverized and dried, $12@$15 per gross ton, depending upon grade; calcined so as to remove most of the combined water, $20 per gross ton, f.o.b. shipping point.

Borax—Granulated, crystals, or powdered in bags, carloads, 5½c. per lb.; in bbls. 5¾c.

Chalk—English, extra light, 5c. Domestic light, 4½c.; heavy, 4c. per lb. all f.o.b. New York.

China Clay (Kaolin)—Crude, $6@$8; washed, $8@$10; powdered, $12@$20; bags extra, per net ton, f.o.b. mines, Georgia; powdered clay, $13@$20, f.o.b. Virginia points. Imported lump, $14@$20, f.o.b. American ports; powdered, $35@$45, f.o.b., quoted at New York.

Emery—Turkish emery, 6c. per lb. Inferior grades, 3½c., f.o.b., from New England points.

Feldspar—No. 1 pottery grade, $6.50@$6.75 per long ton; No. 2 pottery, $5.75; No. 1 soap grade, $7.25@$7.50, f.o.b. cars. No. 1 Canadian, $22, f.o.b. mill.

Fluorspar — Gravel, guaranteed 85 per cent calcium fluoride and not over 6 per cent silica, $20@$22.50 per ton, f.o.b. Illinois and Kentucky mines; gravel, $15; lump, $12.50, f.o.b. Lordsburg, N. M. Ground, acid grade, 97 per cent CaF_2, $30, New Mexico.

Fuller's Earth—16 to 30 mesh, $20 per ton; 30 to 60 mesh, $20; 60 to 100 mesh, $17; 100 mesh and over, $15, f.o.b. Pennsylvania points. English, $23@$25, f.o.b. New York.

Graphite—Ceylon lump, first quality, 4½@6½c. per lb.; chip, 3½@5c.; dust, 2@3½c.; No. 1 flake, 5@6c.; amorphous, crude, $15@$40 per ton. All f.o.b. New York.

Gypsum—Plaster of paris in carload lots sells for $4.25 per 250-lb. bbl., alongside dock, New York.

Kaolin—See China Clay.

Limestone—Crushed, New York State shipping points, ¾ in. size, $1@$1.75 per net ton; 1½ in., $1@$1.25. Prices for other sizes practically the same. Agricultural limestone, $2.50@$3.75 per net ton, f.o.b. eastern shipping points, depending upon analysis.

Magnesite, Calcined — Crude, $12@$15 per ton. High-grade caustic calcined, lump form, $30@$40 per ton. Plastic calcined, $45@$50 in bbls., carload lots, f.o.b. California points. Atlantic seaboard, $60.

Dead-Burned — $33 per net ton, Chewelah, Wash.; $58@$64, Chester, Pa. Austrian grade, $28@$30 per ton, f.o.b., Chester, Pa. (Magnesite brick—See Refractories.)

Mica — India block mica, slightly stained, per lb.; No. 6, 35c.; No. 5, $1.25; No. 4, $2.25; No. 3, $2.90; No. 2, $3.65; No. 1, $5.50. Clear block: No. 6, 50c.; No. 5, $1.75; No. 4 $3.25; No. 3, $5; No. 2, $6.50; No. 1, $8; A1, $6.50@$8.50; extra large, $25; ground, wallpaper grade, $90@$160 per ton (depending upon quantity); ground roofing mica, $25@$70, all f.o.b. New York.

[1]Monazite — Minimum of 6 per cent thorium oxide, $30 per unit, duty paid.

Phosphate Rock—Per long ton, Florida ports, pebble grade: 77 per cent tricalcium phosphate, $9.50 ($10.50 for hard rock); 75 per cent, $8; 75@74 per cent, $7.50; 70 per cent, $4.75; 68 per cent, $4.25; 68@66 per cent, $4.

Pumice Stone — Imported, lump, 3@40c. per lb.; domestic lump, 5c.; ground, 5@6c., all f.o.b. New York.

Pyrites—Spanish fines, per unit, 12c., c.i.f. Atlantic seaport; furnace size, 13c.; Spanish lump, 13@14c.; domestic fines, f.o.b. mines, Georgia, 11@12c.

Silica—Glass sand, $1.25@$2.25 per ton; sand-blast material, $2.25@$4.50, f.o.b. Indiana and Illinois points. Amorphous or decomposed variety, soft silica, 250 mesh, $14; 350 mesh, $18; 450 mesh, $28 per ton. Ganister, crude, $2.50 per ton, f.o.b. Illinois points. Molding sand, building sand, glass sand, $2.25@$3, f.o.b. Pennsylvania points.

Sulphur—$16@$18 per ton for domestic, f.o.b. Texas and Louisiana mines; $18@$20 for export, f.a.s. New York.

Talc—20 to 200 mesh, $7@$12 per ton, f.o.b. Vermont; $8.25@$13, f.o.b. points in Georgia; 200 mesh, $16@$20, f.o.b. Los Angeles.

Mineral Products

Copper Sulphate — Large crystals, 5.65c.; small crystals, 5.55c. per lb., f.o.b. New York.

Potassium Sulphate — Powder, domestic, $1 per unit, basis 90 per cent, f.o.b. New York.

Sodium Nitrate — $2.37½@$2.40 per cwt., ex vessel, Atlantic ports.

Sodium Sulphate—For 95 per cent material, $12.50 per ton, f.o.b. in bulk, Western mines, spot and six months' contract; $17@$20 per ton, New York.

Ferro-Alloys

Ferrotitanium—For 15 to 18 per cent material, $200@$225 per ton, f.o.b. Niagara Falls, N. Y.

Ferrocerium—Per lb., $12@$15.

Ferrochrome—Carload lots, spot and contract, 60 to 70 per cent chromium, 6 to 8 per cent carbon, 11½c. per lb. of chromium contained; 4 to 6 per cent carbon, 12c., f.o.b. works.

Ferromanganese—Domestic 78 to 82 per cent, $59@$60, f.o.b. furnace; English and German, $57@$58.35, c.i.f. Atlantic seaport. Spiegeleisen, 18@20 per cent, $25@$27 per gross ton, f.o.b. furnace.

Ferromolybdenum—Standard grades, carrying from 50 to 60 per cent molybdenum metal, with low sulphur, phosphorus, and arsenic, $2.25 per lb. of contained metal, f.o.b. works. Imported material, $1.70@$2.

Ferrosilicon—For 10 to 15 per cent, per gross ton, f.o.b. works, $38@$40; 50 per cent, $54@$55; 75 per cent, $115@$120.

Ferrotungsten—Domestic, 70 to 80 per cent W, 40@45c. per lb. of contained tungsten, f.o.b. works. Foreign, 50c., duty paid, f.o.b. Atlantic ports.

Ferro-uranium—35 to 50 per cent U, $6 per lb. of U contained, f.o.b. works.

Ferrovanadium—$4.25@$4.50 per lb. of V contained, according to analyses and quantity.

Metal Products

Copper Sheets—Current New York list price, 21.25c. per lb.; wire, 15@15.25c.

Lead Sheets—Full lead sheets, 7½c.; cut lead sheets, 8c. in quantity, mill lots.

Nickel Silver—$27.75c. per lb. for 18 per cent nickel Grade "A" sheets.

Yellow Metal — Dimension sheets, 17.75c.; sheathing, 16.75c.; rods, ⅝ to 3 in., 14.75c.

Zinc Sheets — $8 per 100 lb., less 8 per cent on carload lots, f.o.b. works.

Refractories

Bauxite Brick—56 per cent alumina, $130 per 1,000; 76 per cent, Suprafrax, $200 per 1,000; f.o.b. works, St. Louis and Pittsburgh.

Chrome Brick—$41@$43 per net ton.

Chrome Cement — 40@45 per cent Cr_2O_3, $30@$32 per net ton, and $31 in sacks, carload lots, f.o.b. eastern shipping points.

Firebrick—First quality, 9-in. shapes, $32@$37 per 1,000, Pennsylvania, Ohio and Kentucky.

Magnesite Brick—9-in. straights, $53@$55 per net ton, f.o.b. works.

Silica Brick—9-in., per 1,000, $30@$35 in carload lots, f.o.b. shipping points.

The Iron Trade

Pittsburgh, Jan. 31, 1922

Demand for steel products, on the whole, has shown no change in the last two weeks, and the tonnage of business booked by steel mills in the month of January falls decidedly short of the expectations. Signs appearing in the last week have, however, been of a promising character as to tonnage demand in the future, though not as to prices.

Tin plate is doing quite well, showing a production at close to 75 per cent of capacity, and sheets, wire products, and tubular goods together average about 50 per cent of capacity. Bar, plate, and shape production is light. Rail production is materially increased.

Prices of steel products are extremely unsatisfactory. Though open or "regular" prices are not changed, more tonnage is now sold at concessions than at full prices, and there is keen competition everywhere.

Pig Iron — Basic is off 25c. and foundry iron 50c. from previous quotations, the market being now quotable at $19.50 for bessemer, $18 for basic, and $19 for foundry, f.o.b. Valley furnaces, with $1.96 freight to Pittsburgh. Inquiry is light.

Coke

Connellsville—Furnace, $3.25@$3.50; foundry, $4.25@$4.50.

[1]Foote Mineral Co., Philadelphia, Pa.

COMPANY REPORTS

Consolidated Mining & Smelting Production Increases

BY ALEXANDER GRAY
Written for *Engineering and Mining Journal*

A PRELIMINARY REPORT of the Consolidated Mining & Smelting Co. of Canada makes this comparison of output and value for the last two years:

	1920		1921	
	Production	Value	Production	Value
Gold, oz	46,636	$902,714	51,037	$1,083,232
Silver, oz	1,097,930	1,282,549	1,172,890	791,985
Copper, lb	4,501,594	601,748	3,556,517	306,754
Lead, lb	26,474,652	1,730,024	57,051,110	1,960,999
Zinc, lb	26,995,254	2,810,890	53,131,270	2,551,895

In the tonnage treated and quantity of zinc-lead produced 1921 was a record year for the company and for the Province of British Columbia. The parallel columns afford opportunity for analysis by those who are interested in the situation that confronted producers. The company's operations were characteristic of what all others had to meet. For the 408,346 tons received at the Trail metallurgical works of the company, the monetary return may be said to have been satisfactory but inadequate. Only a fortieth of that tonnage, it is explained, came from private operators. All else was derived from company mines. At any rate, the results are indicative of what is possible when economies are complete and metal markets more responsive. They follow the preceding year in which the management noted there had been "the most drastic period of deflation ever known"—for which $624,115.15 was written off. The following compilation shows these items as they appeared a year ago and how they have been dealt with:

Special bank loan expenditure	$1,750,000
Other bank loans and overdraft	3,601,204
Accounts payable	1,777,463
Ores and metals in process	$3,336,463
Stores and materials	1,486,920

At the end of 1919 there was a carry-over in ores, metals, and smelter product of $2,987,297. Capital commitments—which will be refunded—and labor disputes accentuated the industrial reaction. It is to be emphasized, however, that during 1920 the management complained that "a great deal of trouble was experienced during the early part of the year owing to an insufficient and unsatisfactory ore supply," especially of zinc ores, a situation that no longer exists.

Until settlements are effected and the balance sheet appears, no statement can be made as to the improved financial position. Presumably, and according to informal pronouncements, inventories are not so bothersome. It is even intimated that it is the company's competitors—particularly in the Far East—who are doing hard thinking about the quantity and grade of the lead-zinc-silver ore at the beck and call of the company's board of directors. Of the 348,000 tons dealt with in 1920, 260,000 tons came from the Sullivan Mine, at Kimberley, British Columbia. A greater proportion of the 1921 tonnage was from the Sullivan, where underground developments have surpassed expectations and the utmost optimism prevails. Instead of a scarcity of zinc-bearing ores, the company has been shipping a grade averaging 11 per cent lead and 18 per cent zinc. Obviously the detailed balance sheet will have no inverted box rules about it suggestive of the mortuary or the moribund.

Consolidated production must have been sustained throughout the year; for the total Dominion of Canada output of lead in the first half of 1921 was about 32,875,000 lb., compared with 35,953,717 lb. for the whole calendar year 1920. In the same six months of 1921, the total Canadian production of zinc was 28,236,103 lb., of which the Consolidated contributed 28,218,000 lb. Allowing for everything, the record is the outstanding feature of Canada's mineral industries—apart from Hollinger Consolidated gold results. Ontario and Quebec produced no zinc. British Columbia had the field all to itself. Had prices been at all comparable with those of 1920, some of the Consolidated directors feel, they would be the better enabled to greet the rising morn with a larger chest measurement than Chanticleer—and they would not so vehemently wish the de'il was awa' wi' the excise man.

It has devolved upon the management to liquidate inventories—to thaw out the banking position. Liquidity has preceded further plans for expansion. Kobe and Europe took the Consolidated metals. Once money markets are easier, and in the near future, announcements will be made as to concentration and power facilities. As surety for such plans and what they will entail, apart from copper properties and the program therefor, there is an estimated 5,000,000 tons of zinc-lead-silver ore at the Sullivan mine alone, which may be considered conservative by the more enthusiastic directors. The estimate has a factor of safety. The Sullivan is so big that it is more prudent to underestimate and to merely register the generalization that the gross value of what is determined and what may be approximated—what is recoverable with the new metallurgy—will test the capacity of more than one cornucopia. Yet a leading Canadian mining engineer six months ago, exclaimed: "Sullivan! Sullivan! I never heard of it! Where is it?"

Mining Dividends for January, 1922

The following dividends were paid by mining and metallurgical companies during January, 1922:

Companies in the United States:	Situation	Per Share	Total
American Smelters Sec. pfd. "A"	U. S.	$1.50 Q	$146,071
American Smelters Sec. pfd. "B"	U. S.	1.25 Q	39,855
Cresson Consolidated Gold	Col.	0.10	122,000
Eagle-Picher Lead pfd	Mo., Okla.	1.50 Q	15,000
Homestake Mining, g	S. D.	0.25 M	62,790
Phelps Dodge Corporation, c	U. S. and Mex.	1.00 Q	450,000
Rochester Silver Corporation	Nev.	0.025	44,268
Tonopah Belmont Development, s.g.	Nev.	0.05	75,000
Tonopah Extension, s.g.	Nev.	0.05 Q	64,636
United Eastern, g	Ariz.	0.15 Q	204,455
U. S. Smelting, Refining & Mining, pfd	U. S. and Mex.	0.875 Q	425,556
Companies in Canada:			
Asbestos Corporation	Que.	$1.50 Q	$45,000
Asbestos Corporation pfd	Que.	1.75 Q	70,000
Dome Mines, g	Ont.	0.25 Q	119,167
Hollinger Consolidated Gold	Ont.	0.05 4 wks.	246,000
Kerr Lake, s	Ont.	0.125 Q	75,000
McIntyre Porcupine, g	Ont.	0.05 4 mos.	182,014
Nipissing, s	Ont.	0.30	360,000
Wright-Hargreaves, g	Ont.	0.05	137,500

M, monthly; Q, quarterly; c. copper; g, gold; s, silver.

The dividend record of January contains several additions to the list published three months ago. Cresson Consolidated Gold is again included, after a hiatus lasting since June, 1920; Tonopah Belmont Development Co.'s last payment was 5c. in April, 1921; Nipissing paid 15c. extra, besides the regular quarterly dividend of 15c.; and Wright-Hargreaves paid an initial dividend of 5c. per share. This last is one of the principal producers of the Kirkland Lake district, and the new 175-ton mill, it is predicted, will turn out enough gold to net the company close to $1,000,000 in its first year of operation. The stock is closely held. In addition to the dividends listed, the Star Mining Co., in Idaho, is reported to have paid a dividend of $250,000, though no official advices to this effect have been received.

METAL STATISTICS

Monthly Average Prices of Metals

Silver

	New York		London		Sterling Exchange	
	1921	1922	1921	1922	1921	1922
January	65.950	65.450	39.985	35.035	372.650	421.750
February	59.233	.....	34.745	.....	385.932	.....
March	56.023	.....	32.479	.....	389.806	.....
April	59.337	.....	34.250	.....	391.784	.....
May	59.810	.....	34.165	.....	396.580	.....
June	58.510	.....	34.971	.....	377.236	.....
July	60.260	.....	37.481	.....	362.565	.....
August	61.597	.....	38.096	.....	364.505	.....
September	66.160	.....	40.082	.....	371.725	.....
October	70.970	.....	41.442	.....	386.315	.....
November	68.234	.....	38.750	.....	396.315	.....
December	65.760	.....	35.645	.....	414.880	.....
Year	62.654	.....	36.841	.....	384.191	.....

New York quotations cents per ounce troy, 999 fine. London, pence per ounce, sterling silver, 925 fine.

Copper

	New York		London			
	Electrolytic		Standard		Electrolytic	
	1921	1922	1921	1922	1921	1922
January	12.597	13.465	70.964	65.226	79.119	72.321
February	12.556	.....	70.925	.....	75.925	.....
March	11.976	.....	67.565	.....	71.190	.....
April	12.438	.....	69.381	.....	71.786	.....
May	12.742	.....	73.196	.....	74.298	.....
June	12.697	.....	71.852	.....	75.682	.....
July	12.170	.....	71.155	.....	75.286	.....
August	11.634	.....	68.614	.....	72.705	.....
September	11.948	.....	67.977	.....	72.295	.....
October	12.673	.....	67.327	.....	73.476	.....
November	13.035	.....	66.614	.....	74.386	.....
December	13.555	.....	66.706	.....	74.525	.....
Year	12.502	.....	69.356	.....	74.223	.....

New York quotations, cents per lb. London, pounds sterling per long ton.

Lead

	New York		St. Louis		London	
	1921	1922	1921	1922	1921	1922
January	4.821	4.700	4.747	4.388	23.387	23.667
February	4.373	.....	4.228	.....	20.650	.....
March	4.084	.....	4.000	.....	18.911	.....
April	4.356	.....	4.272	.....	20.589	.....
May	4.952	.....	4.784	.....	23.399	.....
June	4.485	.....	4.293	.....	22.563	.....
July	4.410	.....	4.260	.....	23.399	.....
August	4.382	.....	4.217	.....	23.489	.....
September	4.600	.....	4.392	.....	23.148	.....
October	4.690	.....	4.439	.....	23.679	.....
November	4.683	.....	4.356	.....	24.483	.....
December	4.700	.....	4.369	.....	25.322	.....
Year	4.545	.....	4.363	.....	22.752	.....

New York and St. Louis quotations, cents per lb. London, pounds sterling per long ton.

Tin

	New York				London	
	99%		Straits			
	1921	1922	1921	1922	1921	1922
January	31.470	31.480	36.000	32.100	190.464	163.065
February	28.534	.....	32.142	.....	166.250	.....
March	27.296	.....	28.806	.....	156.024	.....
April	28.990	.....	30.404	.....	163.905	.....
May	31.431	.....	32.500	.....	177.411	.....
June	28.514	.....	29.423	.....	167.506	.....
July	26.755	.....	27.655	.....	164.530	.....
August	25.662	.....	26.301	.....	155.318	.....
September	26.280	.....	26.680	.....	156.750	.....
October	27.278	.....	27.655	.....	156.380	.....
November	28.592	.....	28.935	.....	158.898	.....
December	32.106	.....	32.486	.....	169.738	.....
Year	28.576	.....	29.916	.....	165.265	.....

New York quotations, cents per lb. London, pounds sterling per long ton.

Zinc

	St. Louis		London	
	1921	1922	1921	1922
January	5.413	4.691	25.262	26.321
February	4.928	.....	24.850	.....
March	4.737	.....	25.077	.....
April	4.747	.....	25.530	.....
May	4.848	.....	26.923	.....
June	4.421	.....	26.750	.....
July	4.239	.....	26.262	.....
August	4.186	.....	25.068	.....
September	4.235	.....	25.256	.....
October	4.605	.....	26.315	.....
November	4.667	.....	25.949	.....
December	4.835	.....	26.900	.....
Year	4.655	.....	25.845	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Antimony, Quicksilver and Platinum

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1921	1922	1921	1922	1921	1922
January	5.258	4.463	48.440	49.960	73.400	97.260
February	5.250	.....	49.545	.....	70.227	.....
March	5.282	.....	46.796	.....	72.463	.....
April	5.137	.....	45.423	.....	73.404	.....
May	5.250	.....	47.000	.....	73.740	.....
June	5.087	.....	46.846	.....	74.942	.....
July	4.735	.....	44.950	.....	70.440	.....
August	4.597	.....	45.028	.....	73.222	.....
September	4.564	.....	42.660	.....	75.960	.....
October	5.085	.....	39.840	.....	81.800	.....
November	4.734	.....	39.804	.....	82.609	.....
December	4.500	.....	49.212	.....	78.192	.....
Year	4.957	.....	45.462	.....	75.033	.....

(a) Antimony quotations in cents per lb. for ordinary brands. (b) Quicksilver in dollars per flask. (c) Platinum in dollars per ounce.

Pig Iron, Pittsburgh

	Bessemer		Basic		No. 2 Foundry	
	1921	1922	1921	1922	1921	1922
January	33.96	.....	31.96	.....	33.88	.....
February	28.96	.....	26.96	.....	30.25	.....
March	28.16	.....	26.46	.....	27.85	.....
April	26.96	.....	24.46	.....	26.77	.....
May	26.21	.....	23.84	.....	25.56	.....
June	24.96	.....	22.66	.....	24.38	.....
July	22.84	.....	20.76	.....	22.36	.....
August	21.96	.....	20.29	.....	21.53	.....
September	21.96	.....	21.21	.....	22.82	.....
October	21.96	.....	20.96	.....	22.96	.....
November	21.96	.....	20.96	.....	22.74	.....
December	21.96	.....	20.65	.....	21.96	.....
Year	25.15	.....	23.43	.....	5.26	.....

In dollars per long ton.

Monthly Crude Copper Production

	1921			
	September	October	November	December
Alaska shipments	3,709,844	6,160,847	4,841,506	8,881,013
Anaconda	(a)	(a)	(a)	(a)
Arizona Copper	(a)	(a)	(a)	(a)
Calumet & Arizona	(a)	(a)	(a)	(a)
Calumet & Hecla	(a)	(a)	(a)	(a)
Other Lake Superior	4,250,000	4,250,000	5,500,000	5,500,000
Chino	(a)	(a)	(a)	(a)
Con. Ariz. Smelting	(a)	(a)	(a)	(a)
East Butte	949,988	1,000,000	750,000	(a)
Inspiration	(a)	(a)	(a)	(a)
Magma	(a)	(a)	(a)	(a)
Miami	4,268,000	5,084,000	4,514,000	5,030,941
Nevada Cons	(a)	(a)	(a)	(a)
New Cornelia	1,527,493	1,536,725	1,605,936	1,717,183
Old Dominion	(a)	(a)	(a)	(a)
Phelps Dodge	(a)	(a)	(a)	(a)
Ray	(a)	(a)	(a)	(a)
Shattuck Arizona	(a)	(a)	(a)	(a)
United Verde	(a)	(a)	(a)	(a)
United Verde Extension	(a)	(a)	(a)	(a)
Utah Copper	(a)	(a)	(a)	(a)
Others, estimated	9,150,000	5,200,000	11,130,000	8,500,000
Total United States	23,855,317	23,231,572	28,341,442	29,629,137
Imports: Ore and concentrates, matte	6,268,635	8,445,551	7,297,583	14,844,641
Imports of blister, unrefined	8,614,851	23,360,893	10,561,454	14,731,185
Imports of refined	10,553,792	761,125	2,139,144	2,447,925
Grand total	49,292,595	55,799,141	49,339,623	61,652,888
Backus & Johnston	350,000	198,000	900,000	822,000
Boleo	771,305	1,041,863	976,815	954,765
Cananea	(a)	(a)	(a)	(a)
Cerro de Pasco	4,594,000	5,330,000	5,618,000	5,536,000
Chile	4,000,000	4,000,000	4,000,000	4,000,000
Cons. M. & S. of Canada	261,855	156,940	200,000	313,290
Falcon Mines	511,280	550,710	518,600	550,800
Furukawa	2,744,371	2,541,508	.....	.....
Granby Cons	2,720,761	2,593,230	2,365,017	2,215,403
Hampden Cloncurry	(a)	(a)	(a)	(a)
Katanga	6,136,515	6,189,435	5,984,370	.....
Mount Morgan	(a)	(a)	(a)	(a)
Mount Lyell	1,204,000	1,220,000	71,068,000	.....
Phelps Dodge Mexican	(a)	(a)	(a)	(a)
Sumitomo	1,674,865	1,444,316	2,910,964	.....

(a) No copper produced during this month.

Comparative Annual Copper Production

	1919	1920	1921
January	135,733,511	121,903,744	90,596,597
February	111,649,512	117,450,000	86,682,941
March	102,040,460	120,309,316	91,046,345
April	98,808,998	116,078,871	46,946,523
May	92,652,975	114,964,207	25,310,511
June	95,856,570	116,107,856	24,623,693
July	100,369,247	109,729,610	22,033,739
August	107,994,040	112,460,254	23,248,398
September	108,703,075	104,9195,62	23,855,316
October	115,143,143	105,231,571	23,231,572
November	117,289,735	106,700,178	28,341,442
December	102,997,633	95,709,009	29,629,137

MINING STOCKS

Week Ended January 28, 1922

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Ahmeek	Boston	65	61	63	Sept. '20, Q	$0.50
Alaska-Br. Col. new.	N. Y. Curb	2⅜	2⅛	2⅛	.....	....
Allouez	Boston	32½	30	30	Mar. '19	1.00
Anaconda	New York	50⅛	47⅛	47⅛	Nov. '20, Q	1.00
Arcadian Consol.	Boston	3	2½	2½	.....	....
Ariz. Com'l	Boston	9⅛	9	9	Oct. '18, Q	0.50
Big Ledge	N. Y. Curb	*29	*25	*26	.....	....
Bingham Mines	Boston	14	13½	13½	Sept. '19, Q	0.25
Calumet & Arizona	Boston	60	58½	58½	Dec. '21, Q	0.50
Calumet & Hecla	Boston	285	268	275	June '20, Q	5.00
Canada Copper	N. Y. Curb	*28	*25	*26	.....	....
Centennial	Boston	12½	9½	12½	Dec. '18, SA	1.00
Cerro de Pasco	New York	35½	33⅜	34	Mar. '21, Q	0.50
Chile Copper	New York	18⅛	16⅜	17⅜	.....	....
Chino	New York	28⅜	26⅜	26½	Sept. '20, Q	0.37½
Columbus Rexall	Salt Lake	*34	*27	*31½	.....	....
Con. Arizona	N. Y. Curb	....	....	3	Dec. '18, Q	0.05
Con. Copper Mines	N. Y. Curb	1⅛	1 1/16	1 1/16	.....	....
Copper Range	Boston	45¼	44	45	Sept. '20, Q	0.50
Crystal Copper	Boston Curb	*62	*55	*61	.....	....
Davis-Daly	Boston	9¼	7	8¼	Mar. '20, Q	0.25
East Butte	Boston	12¼	11	11⅛	Dec. '19, A	0.50
First National	Boston Curb	*78	*70	*75	Feb. '19, SA	0.15
Franklin	Boston	1⅞	1⅝	1⅝	.....	....
Gadsden Copper	Boston Curb	*40	*30	*30	.....	....
Granby Consol.	New York	30⅜	29⅛	29⅛	May '19, Q	1.25
Greene-Cananea	New York	28⅛	27	28⅛	Nov. '20, Q	0.50
Hancock	Boston	†3	†2½	2½	.....	....
Howe Sound	N. Y. Curb	2⅛	2⅛	2⅛	Jan. '21, Q	0.05
Inspiration Consol.	New York	41	38⅛	38⅛	Oct. '20, Q	1.00
Iron Cap	Boston Curb	7⅜	7⅛	7⅛	Sept. '20, K	0.25
Isle Royale	Boston	26⅛	25¼	26	Sept. '19, SA	0.50
Kennecott	New York	30¼	28	28⅛	Dec. '20, Q	0.50
Keweenaw	Boston	†1⅛	†1¼	1⅛	.....	....
Lake Copper	Boston	2⅜	2⅛	2⅛	.....	....
La Salle	Boston	2	1¾	2	.....	....
Magma Copper	N. Y. Curb	30	28½	29⅛	Jan. '19, Q	0.50
Majestic	Boston Curb	*3	*3	*3	.....	....
Mason Valley	Boston	1⅛	1⅛	1⅛	.....	....
Mass Consolidated	Boston	2⅜	2⅛	2⅛	Nov. '17, Q	1.00
Miami Copper	New York	28	27	27⅜	Nov. '21, Q	0.50
Michigan	Boston	2⅛	2⅛	2⅛	.....	....
Mohawk	Boston	59	56⅜	57⅛	Nov. '20, Q	1.00
Mother Lode Coa.	N. Y. Curb	9⅛	8	8	.....	....
Nevada Consol.	New York	15⅛	14⅛	14⅛	Sept. '20, Q	0.25
New Cornelia	Boston	19	18⅛	18⅛	Aug. '20, K	0.25
North Butte	Boston	14	12⅞	13⅛	Oct. '18, Q	0.25
North Lake	Boston	†*40	†*20	*25	.....	....
Ohio Copper	N. Y. Curb	....	....	*10	.....	....
Old Dominion	Boston	27	25	26	Dec. '18, Q	1.00
Osceola	Boston	37⅛	35	35⅛	June '20, Q	0.50
Phelps Dodge	Open Mar.	†180	†170	...	Jan. '22, Q	1.00
Quincy	Boston	47	45	45	Mar. '20, Q	1.00
Ray Consolidated	New York	15⅜	14⅛	14⅜	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	*13	*3	*7	.....	....
St. Mary's Min. Ld.	Boston	47	45	45	Dec. '21, K	1.00
Seneca Copper	Boston	17⅜	17	17⅛	.....	....
Shannon	Boston	1⅜	1 1/16	1 1/16	Nov. '17, Q	0.25
Shattuck Arizona	New York	8⅜	8⅛	8⅛	Jan. '20, Q	0.25
South Lake	Boston	*60	*60	*60	.....	....
Superior & Boston	Boston	1	1	1	.....	....
Tenn. C. & C. cfs	New York	10¾	10	10⅛	May '18, I	1.00
Tuolumne	Boston	*70	*63	*65	May '13,	0.10
United Verde Ex.	Boston Curb	30⅛	29	29⅛	Nov. '21, Q	0.25
Utah Consol.	Boston	1⅜	1⅛	1⅛	Sept. '18,	0.25
Utah Copper	New York	64⅜	62⅛	62⅛	Dec. '21, Q	0.50
Utah Metal & T.	Boston	1⅛	1 1/16	1 1/16	Dec. '17,	0.30
Victoria	Boston	1⅛	1⅛	1⅛	.....	....
Winona	Boston	*45	*45	*45	.....	....
Wolverine	Boston	12	10⅛	12	.....	....
NICKEL-COPPER						
Internat. Nickel	New York	12⅜	12⅛	12⅛	Mar. '19,	0.50
Internat. Nickel, pfd	New York	72	70	71⅛	Nov. '21, Q	1.50
LEAD						
National Lead	New York	90⅞	86⅜	87	Dec. '21, Q	1.50
National Lead, pfd	New York	112⅜	112⅛	112⅛	Dec. '21, Q	1.75
St. Joseph Lead	New York	13	13	13	Dec. '21, Q	0.25
QUICKSILVER						
New Idria	Boston	†2	†1	1	.....	....
ZINC						
Am. Z. L. & S.	New York	14⅛	13⅜	13⅛	May '20,	1.00
Am. Z. L. & S. pfd.	New York	39⅜	39⅛	39⅜	Nov. '20, Q	1.50
Butte C. & Z.	New York	6⅜	5⅞	5⅞	June '18,	0.50
Butte & Superior	New York	28⅛	24⅛	25	Sept. '20,	1.25
Callahan Zn-Ld	New York	6⅜	5⅛	5⅜	Dec. '20, Q	0.50
New Jersey Zn.	N. Y. Curb	136	131	133½	Nov. '21, Q	2.00
Yellow Pine	Los Angeles	...	...	*50	Sept. '20, Q	0.03

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Hamilton B. Wills; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Commerce and Oil; Colorado Springs, The Financial Press, N. Y.

Stock	Exch.	High	Low	Last		Last Div.
GOLD						
Alaska Gold	New York	⅛	⅛	⅛	.....	....
Alaska Juneau	New York	⅛	⅛	⅛	.....	....
Carson Hill	New York	13⅛	12⅜	13⅛	.....	....
Cresson Consol. G.	N. Y. Curb	3	2 1/16	2 1/16	Jan. '22, Q	$0.10
Dome Extension	Toronto	*77	*75	*77	.....	....
Dome Mines	New York	22	20⅜	21½	Jan. '22, Q	0.25
Florence Goldfield	N. Y. Curb	*23	*21	*21	.....	....
Golden Cycle	Colo. Springs	*75	*71	*75	June '21, Q	0.02
Goldfield Consol.	N. Y. Curb	4*	*4	*4	Dec. '19,	0.05
Hollinger Consol.	Toronto	7.97	7.93	7.95	Dec. '21, 4 wks	0.05
Homestake Mining	New York	57	55	57	Dec. '21, M	0.25
Kirkland Lake	Toronto	*35	*32	*32	.....	....
Lake Shore	Toronto	1.37	1.31	1.37	Nov. '21, K	0.02
McIntyre-Porcupine	Toronto	2.45	2.25	2.45	Jan. '22, K	0.05
Porcupine Crown	Toronto	*16	*14	*15½	July '17,	0.03
Porcupine V. N. T.	Toronto	*20½	*19	20½	.....	....
Portland	Colo. Springs	*35	*35	*55	Oct. '20, Q	0.01
Schumacher	Toronto	*35½	*32	*35½	.....	....
Silver Pick	N. Y. Curb	*6	*6	*6	.....	....
Teck Hughes	Toronto	*29	*28	*29	.....	....
Tom Reed	Los Angeles	1.00	*46½	*90	Dec. '19,	0.02
United Eastern	N. Y. Curb	2⅛	2	2⅛	Oct. '21, Q	0.15
Vindicator Consol.	Colo. Springs	29	22	29	Jan. '20, Q	0.01
White Caps Mining	N. Y. Curb	*6	*4	*4	.....	....
Yukon Gold	N. Y. Curb	1⅛	1 1/16	1⅛	June '18,	0.02½
SILVER						
Batopilas Mining	New York	⅛	⅛	⅛	Dec. '07, I	0.12½
Beaver Consol.	Toronto	*21½	*20	*20½	May '20, K	0.03
Coniagas	Totonto	1.40	1.30	1.40	May '21, Q	0.12½
Crown Reserve	Toronto	*16	*14	*14	Jan. '17,	0.05
Kerr Lake	N. Y. Curb	3⅜	3⅛	3⅛	Jan. '22, Q	0.12½
La Rose	Toronto	*34	*33	*34	Apr. '18,	0.02
McKinley-Dar.-Sav.	Toronto	*18⅛	*15⅛	*18⅛	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	1.05	1.00	1.05	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	6⅛	6	6⅛	Jan. '22, Q	0.15
Ontario Silver	New York	5⅛	5	5	Jan. '19, Q	0.50
Ophir Silver	N. Y. Curb	...	...	*12	Jan. '12,	0.10
Temiskaming	Toronto	*34½	*32	*34½	Jan. '20, K	0.04
Trethewey	Toronto	*8	*7½	*7½	Jan. '19,	0.05
GOLD AND SILVER						
Boston & Montana	N. Y. Curb	*68	*54	*56	.....	....
Cash Boy	N. Y. Curb	*6	*5	*5	.....	....
Dolores Esperanza	N. Y. Curb	...	...	*90	.....	....
El Salvador	N. Y. Curb	*4	*4	*4	.....	....
Jim Butler	N. Y. Curb	...	...	*6	Aug. '18, SA	0.07
Jumbo Extension	N. Y. Curb	*3	*3	*3	June '16,	0.05
MacNamara M.&M.	N. Y. Curb	*8	*7	*8	May. '10,	0.02½
Tonopah-Belmont	N. Y. Curb	1⅛	1 1/16	1⅛	Jan. '22, Q	0.05
Tonopah-Divide	N. Y. Curb	*75	*60	*63	.....	....
Tonopah-Extension	N. Y. Curb	1⅜	1⅛	1⅛	Jan. '22, Q	0.05
Tonopah Mining	N. Y. Curb	1⅜	1 1/16	1 1/16	Oct. '21, SA	0.05
West End Consol.	N. Y. Curb	*84	*76	*84	Dec. '19, SA	0.05
SILVER-LEAD						
Caledonia	N. Y. Curb	...	...	*6	Jan. '21, M	0.01
Cardiff M. & M.	Salt Lake	1.02½	1.02½	1.02½	Dec. '20,	0.15
Chief Consol.	Boston Curb	3⅛	1 1/16	3 1/16	Aug. '21, Q	0.05
Consol. M. & S.	Montreal	20¾	19½	19½	Oct. '20, Q	0.62½
Daly Mining	Salt Lake	†3.00	†1.00	...	July '20, Q	0.10
Daly-West	Boston	†3	†2	...	Dec. '20, Q	0.25
Eagle & Blue Bell	Boston Curb	†3	†2½	2½	Apr. '21, K	0.05
Electric Point	Spokane	*4½	*4	*4½	May '20, SA	0.03
Federal M. & S.	New York	†9⅛	†2	10	Jan. '09,	1.50
Federal M. & S., pfd	New York	41	40	40	Dec. '21, Q	1.00
Florence Silver	Spokane	*18	*18	*18	Apr. '19,	0.01½
Grand Central	Salt Lake	*41	*40	*40	Jan. '21, K	0.01
Hecla Mining	N. Y. Curb	4⅞	4 1/16	4 1/16	Dec. '21, Q	0.17
Iron Blossom Con.	N. Y. Curb	*21	*20	*20	Dec. '21, Q	0.02½
Judge M. & S.	Salt Lake	†3.00	†2.25	2.50	Sept. '20, Q	0.12½
Marsh Mines	N. Y. Curb	...	...	*4	June '21, I	0.02
Prince Consol.	Salt Lake	*13½	*10	*13½	Nov. '17,	0.02½
Rambler-Cariboo	Spokane	*4½	*4	*4	Feb. '19,	0.01
Rex Consol.	N. Y. Curb	*7	*6	*7	.....	....
South Hecla	Salt Lake	†1.05	†30	...	Sept. '19, K	0.15
Standard Silver-Ld.	N. Y. Curb	*12	*12	*12	Oct. '17,	0.05
Stewart Mines	N. Y. Curb	*4	*3	*3	Dec. '15,	0.05
Tamarack-Custer	Spokane	2.10	1.90	1.90	Jan. '21, K	0.04
Tintic Standard	Salt Lake	2.50	2.02½	2.50	Dec. '21, Q	0.05
Utah Apex	Boston	2⅜	2⅛	2⅛	Nov. '20, K	0.25
Wilbert Mining	N. Y. Curb	*1	*1	*1	Nov. '17,	0.01
VANADIUM						
Vanadium Corp.	New York	35⅞	33	33½	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp.	Montreal	50½	48½	50½	Jan. '22, Q	1.50
Asbestos Corp., pfd.	Montreal	78	76¼	78	Jan. '22, Q	1.75
SULPHUR						
Freeport, Texas	New York	15	12⅛	14⅛	Nov. '19, Q	1.00
Texas Gulf	New York	42⅛	40⅛	41⅛	Dec. '21, Q	1.00
MINING, SMELTING AND REFINING						
Amer. Sm. & Ref.	New York	47⅛	45⅞	46⅛	Mar. '21, Q	1.00
Amer. Sm.& Ref. pf.	New York	90⅛	89¼	89¼	Dec. '21, Q	1.75
Am. Sm. pf. A	New York	87½	87½	87½	Jan. '22, Q	1.50
U. S. Sm. R. & M.	New York	36¼	36¼	36¼	Jan. '21, Q	0.50
U.S. Sm.R.& M. pf.	New York	43¼	43¼	43¼	Jan. '22, Q	0.87½

NEW MACHINERY AND INVENTIONS

Welding Engineer Saves Smelter Big Sum

Some time ago the Bunker Hill & Sullivan Mining and Concentrating Co., Kellogg, Idaho, had 26 8-ton cast iron melting pots that had been so badly cracked in service at its smelter that they had either to be scrapped or reclaimed in some manner. They represented an investment of $31,200, but their value as scrap would be less than a tenth of that amount, from which would have to be deducted the cost of transportation to market and reduction, so that the alternative of reclamation was important. Attempts to weld them by the electric-arc process proved failures. The first experiments with gas welding resulted disappointingly also, but the oxy-acetylene process seemed to offer greater promise of success, and the engineering department of one of the large apparatus manufacturers was given an opportunity to work out the problem.

The engineer in charge of the work not only successfully welded several of the pots, which have now been some time restored to service, but conducted the demonstration so that other operators could proceed with reclamation of the remaining pots. The officials of the Bunker Hill & Sullivan Mining and Concentrating Co. were so satisfied with the results obtained that they at once ordered a complete installation of the equipment used, including generators for acetylene, and in the future it will be used on work of this kind and for general welding and cutting at the mine and smelter in making repairs to broken and worn machinery and plant structures.

It should not be concluded, however, that the oxy-acetylene service engineer accomplished his demonstration without some pioneering to develop the best method of procedure. For example, when he tried to pre-heat the first pot in an improvised charcoal furnace, he discovered that 26 sacks of charcoal burning at one time around the pot little more than warmed it. It was not until he supplemented this heat with a blast from an oil and compressed-air line and covered the furnace and casting with asbestos paper that he succeeded in securing the pre-heat necessary to proceed with the welding. The pots had been subjected to such high temperatures in service that a large part of the carbon was burned out as in the grate bars of furnaces. This made it necessary to bring the pots to a high temperature before beginning to weld in order to effect a homogeneous weld. Of course the pots were annealed after welding to restore the original structure.

The welding demonstration described was conducted by one of the service engineers of the Oxweld Acetylene Co.'s Seattle branch. The Northport Smelter Co., hearing of the success of the work at Kellogg, Idaho, also ordered Oxweld apparatus especially for the reclamation of melting pots.

MELTING POT PRELIMINARY TO WELDING

COMPLETED WELD ON EIGHT-TON POT

"Hopcalite"—A Destroyer of Carbon Monoxide Gas

After considerable research on the part of the U. S. Bureau of Mines, the Chemical Warfare Service of the U. S. Army and a number of scientists, a mixture of metallic oxides, known as "hopcalite," which, when placed in a gas mask canister, acted to destroy carbon monoxide gas, was developed.

Recognizing the great value of a carbon monoxide mask for industrial use the Mine Safety Appliances Co., Pittsburgh, Pa., undertook the development of masks suitable for different industrial conditions in collaboration with the scientists, utilizing "hopcalite" as the element for removing carbon monoxide.

This work, after many months of perfecting and testing, has culminated in the two types of masks—one type for use against carbon monoxide around blast furnaces and producer plants, and the other an "All-Service" type, for fire departments, and mine fire fighting, where smoke and other gases in addition to carbon monoxide may be encountered.

The U. S. Bureau of Mines was especially interested in developing the carbon monoxide absorbent not only because of its military importance but because of the industrial application for such a material after the war. After the war the Pittsburgh Experiment Station of the Bureau of Mines continued experiments on the use and limitations of carbon monoxide gas masks.

A New Drum- and Scoop-Type Feeder

A combination drum and scoop-type feeder, the largest size of which has a capacity rating of 2,000 tons of dry ore per twenty-four hours, has recently been designed. Such a combination enables the feeder to take a large initial feed and several hundred per cent circulating load as well. The drum of the larger feeder is 48 in. in diameter and allowance is provided for a scoop with a radius of 48 to 54 in., as may be required by the customer. Aside from its large capacity, all parts are reversible. This enables the purchaser to reduce his stock when he has mills operating in opposite directions, as by merely changing the parts the same feeder can be used on a mill rotating in clockwise or counter-clockwise direction. Parts are made replaceable to take care of ordinary wear, so that the cost of renewing parts is small.

The initial feed is fed by a chute to the opening in the drum. A scoop on the outside of the drum operates in the ordinary feed box, but it does not have to handle large material; therefore, wear is greatly reduced and there is no danger of breakage to the box. This feeder is manufactured by the Hardinge Co., 120 Broadway, New York.

Device That Makes Measuring a One-Man Job

A convenient aid in measuring with a tape is found in a tape-holding pin known as "Sell Pin," which is made of brass and can be attached to any measuring tape in a few seconds by inserting the loop at the end of the tape into the open loop of the pin, and then closing the pin loop with a pair of pliers or a hammer. The device is made in two sizes by Augustus H. Sell, 858 South 13th St., Newark, N. J.

INDUSTRIAL NOTES

Wilson Welder & Metals Co. have moved their general offices and Bush Terminal factory to 132 King St., New York.

C. L. Bryden, formerly with the Kelly Filter Press Co., is now eastern representative for the Vallez Rotary Filter Press, with offices at 95 Liberty St., New York.

Gibbons Bros., Ltd., Dudley, Worcester, England, has been appointed as representative for the British Isles of W. S. Rockwell Co., furnace engineers and contractors.

The Carroll Chain Co., Columbus, Ohio, is specializing on steam-shovel loading chains designed to meet the requirements of open-cut mining. Daniel Carroll is president and general manager of the company.

H. B. Marshall, former manager of the St. Louis branch of the Electric Storage Battery Co., Philadelphia, Pa., has been placed in charge of railway battery sales, with headquarters in Philadelphia.

List prices for Hercules No. 6 blasting caps were reduced $3 per 1,000, effective Jan. 3. Hercules No. 8 blasting caps were also reduced $5 per 1,000 and Hercules electric blasting copper wires, $1 per 100.

The Bucyrus Co., of South Milwaukee, Wis., with northwestern sales office at 608 Pittock Block, Portland, Ore., announces the appointment of A. R. Hance as northwestern sales manager, succeeding L. T. Russell, who has resigned after ten years of service with the company.

Lippincott, Mills & Co., Inc., have been granted a New York charter to deal in coal, coke, ores, scrap, iron and steel products and ferro-alloys, and to do a general importing and exporting business. The new company has offices at 17 Battery Place, New York, and in the Hippodrome building, Cleveland. G. W. Lippincott is president and William H. Mills is vice-president and treasurer.

Four gifts from various manufacturing and mining companies have added to the equipment of the department of mining and metallurgy of the University of Wisconsin in the last year. A Diester sand-concentrating table, manufactured by the Diester Machine Co., of Fort Wayne, Ind., and a Diester slime classifier were presented to the department by the Burgess Laboratories, of Madison. The Mineral Point Zinc Co., Galena, Ill., donated a 10-in. rock breaker and a set of 18-in. crushing rolls to the equipment of the department.

C. B. Stranahan, of 82 Beaver St., New York, has been appointed sole agent in the United States for the Tharsis Sulphur & Copper Co., of Glasgow, Scotland, for the sale of lump pyrites, fine pyrites, both crude and washed, and morongo (roasted and leached cinder—a high-grade iron ore). The Tharsis company has one of the largest deposits in the Huelva district, Spain. Mr. Stranahan has been in the pyrites business for thirty years. He was connected with the old Davis mine, at Rowe, Mass., the first pyrites mine opened up in the United States. This property was closed down in 1912, when worked out.

TRADE CATALOGS

Lubrication—Steam valve and cylinder lubrication is very thoroughly covered in a well-illustrated booklet issued by the Vacuum Oil Co., New York, entitled "Stationary Steam Engines." Part 1 deals with reciprocating steam engines, and Part 2 with boiler plant and steam production.

Well Equipment.—Catalog 21, of the Parkersburgh Rig & Reel Co., of Parkersburg, W. Va., describes in detail the complete line of Parkersburg oil- and gas-well drilling equipment and wooden and steel tankage. The issue is bound in cloth, contains 506 pages, and is well illustrated. Many valuable tables are included.

Diamond Drills.—The E. J. Longyear Co., Minneapolis, Minn., has issued Bulletin No. 16, "Diamond Core Drills." This publication defines and illustrates the general features of Longyear drills. On page 18 is given a table specifying sizes, capacities, diameters, horsepower required, and shipping weights of the various types.

Heat Wastes.—The Uehling Instrument Co., Combustion Engineers, Paterson, N. J., has recently issued Bulletin 222, "Magnitude of the Power Plant's Chimney Loss," and Bulletin 221, "Relation Between CO_2 and Money Wasted Up the Chimney." These bulletins contain charts and tables descriptive of heat losses in the power plant and other interesting data.

Furnace Linings.—The Quigley Furnace Specialties Co., 26 Cortlandt St., New York, has issued a bulletin presenting information, with illustrations, regarding refractory linings and the use of "Hytempite" in power-plant work, as well as its uses in connection with "Carbo sand" for baffles, patching boiler settings, and other purposes. Information is also given concerning the uses of "Insulbrix."

Potash and Borax.—Weir Brothers & Co., 25 Broad St., New York, has issued an attractively printed fourteen-page pamphlet on the potash and borax industry of the United States. Particular emphasis is laid on the new discovery of a colemanite deposit in Nevada, recently described in *Engineering and Mining Journal*, and its exploitation by the West End Chemical Co. Much statistical and market information is supplied.

Centrifugal Pumps—Goulds Mfg. Co., Seneca Falls, N. Y., have issued Bulletin No. 123, which illustrates and describes Goulds steam turbine driven centrifugal pump units, consisting of centrifugal pumps connected to Lee steam turbines. Owing to its many advantages, the steam turbine driven centrifugal pump has practically become the standard type for boiler feeding in steam power plants of medium and large capacity.

Centrifugal Pumps.—An instruction book which covers the erection, operation, and repair of Worthington horizontal, centrifugal volute pumps has been issued by the Worthington Pump & Machinery Corporation, 115 Broadway, New York. Those desiring to secure a copy of the pamphlet should write for Bulletin 605 K. The book covers seventy-two pages, which, in addition to the instructions given, also contains diagrams, tables, and other useful information.

Car Unloaders.—The Jeffrey Manufacturing Co., of Columbus, Ohio., has issued Bulletin No. 360, which features the Jeffrey portable car unloader, for unloading coal from hopper-bottom or gondola types of railroad cars. The design of the unloader is such as to enable it to meet various conditions of unloading. It is so constructed as to require a minimum of space in which to operate and can readily be placed in between the car hopper door and the rails. Where conditions permit, a more permanent arrangement can be had by placing the unloader underneath the rails and thus eliminate the necessity of resetting it for each car.

Power-House Equipment.—The Jeffrey Manufacturing Co., of Columbus, Ohio., is issuing catalog No. 345, "Coal and Ashes Handling Machinery." Twelve distinctive types of Jeffrey power-house equipments for economically meeting a wide range of capacity requirements in various sizes of plants are illustrated and described in this catalog. It will undoubtedly be of valuable assistance in the selection of the proper type of equipment for new power houses, installation of new equipment which can later be extended as conditions warrant, making temporary extensions to present equipment, or replacing worn-out or inadequate handling machinery.

Water Wheels.—The Pelton Water Wheel Co., of San Francisco and New York, has issued Bulletin No. 17, "Pelton Water Wheels (impulse turbines) and Reaction Turbines." The bulletin describes the various types of hydraulic equipment manufactured by the company, and discusses their application both to the generation of hydro-electric power and to the direct operation of many different kinds of machinery. Some space is also devoted to governors and to pressure-regulating devices. The bulletin comprises forty-eight pages, and is illustrated by a number of drawings and photographs. Copies may be obtained upon application to either office of the company.